EDWARD BARTON

1858 – 1942

Pioneer Electrical Engineer

S.A.PRENTICE

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FIG. 1. Portrait of E.G.C. Barton (1858–1942).

EDWARD BARTON (1858–1942)
PIONEER ELECTRICAL ENGINEER

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ABSTRACT

This biography records the career of Edward Gustavus Campbell Barton, MIEE, FRMetS, FRGS, AMIEAust. It shows that he made a unique contribution to the development of electrical engineering in Queensland and particularly to the establishment of electricity supply through his ability, enterprise and industry. Further, the outstanding part that he played in promoting technical education and in forming professional engineering societies in Queensland, as well as in taking a significant part in the establishment and early development of the University of Queensland is brought to light.

While the account is woven around Barton's career, it also provides a detailed, illustrated record of the history of power system engineering in Brisbane from the inception of electricity supply in 1888 to the early 1920's.

INTRODUCTION

Engineering heritage studies for a particular era typically result in focussing attention on individuals of unusual achievement in their specialist fields. Such studies in Brisbane in 1984 led to the publication by the Queensland Division of the Institution of Engineers, Australia of a booklet entitled *Eminent Queensland Engineers*. (1) Edward Barton (Fig. 1) was included in a preliminary selection list and initial enquiries showed that his contribution to the development of electrical engineering in Queensland was exceptional. His career is outlined in the booklet but to provide more detail a paper on his work was presented by the author to a meeting of the Queensland Division in June 1985. (2) The present account expands further the story of Barton's career and also resolves many of the inconsistencies found in earlier writings about the electricity supply industry.

The illustrations — many of them over ninety years old, and not previously published — provide a unique record of early electrical technology in Queensland.

Barton's career in Queensland which began in 1884 could be regarded as concluding at the end of 1915. Thereafter he made his home in Europe but because he retained his position as a Director of the City Electric Light Co. Ltd until 1918 and as a Director of the Ipswich Electric Supply Co. Ltd until 1925, some events up to the early 1920's are included.

Abbreviations and Symbols

A. - ampère (unit of current); a.c. - alternating current; c.p. - candle power; d.c. - direct current; ft - feet; h.p. - horse power; Hz - frequency (cycles per second); in. - inch; kW - kilowatt (unit of power); kWh - kilowatt-hour (unit of energy); lb. - pound (mass); £ - pound (unit of currency, Imperial system); rpm - revolutions per minute; sq. - square; V. - volt (unit of electrical pressure).

Currency and Measurements

This biography relates to a period before Australian currency and measurements were converted to the decimal and metric systems respectively; hence the Imperial systems have been retained. In 1966 Australian currency was changed from pounds, shillings and pence (£.s.d.) to dollars and cents at the rate of £1 = $2; one shilling (12 pence) = 10 cents.

Measurement conversions used herein are:

1 foot = 0.305 m
1 yard = 0.91 m
1 mile = 1.61 km
1 gallon = 4.54 litre
1 pound (lb.) = 0.45 kg
1 ton (2240 lb.) = 1.02 tonne
1 horse power = 746 watts (0.746 kW)

TRAINING AND EXPERIENCE TO 1882

Edward Gustavus Campbell Barton (Fig. 1) was born on 13 December 1858 in Melbourne, Victoria, the second son of George Elliott Barton and Jane Crichton Campbell. George Barton was born in Ireland in 1825 and having decided to study for the bar was admitted as a student of King's Inn, Dublin in 1845. In 1847 he was admitted to Gray's Inn, Dublin and in 1849 obtained his Bachelor of Arts degree from the University of Dublin. He was admitted as a barrister-at-law in the same year.

In 1852 he emigrated to Victoria and two years later, when aged 29 years, married Jane Campbell, an immigrant from Ayrshire, Scotland. George Barton practised as a barrister in Melbourne and in 1859 was elected as Member for North Melbourne in the Legislative Assembly; he retired from Parliament in 1860, when he and his wife with their daughter and two sons moved to Ballarat, Victoria.

In 1862 the family moved to New Zealand and George Barton (3) commenced practice as a barrister-at-law and solicitor in Dunedin. It is stated that —

> though a successful advocate with remarkable power of concentration, he had an impulsive and highly excitable temperament and was frequently at loggerheads with bench and bar.

His eldest son also practised law. (4)

The Otago Boys High School Register shows George Barton's sons there in '1871–2' suggesting that Edward left school at 14 years of age. Prior to this the boys possibly attended the High Street School (known as 'Parks') as this was the school nearest the Barton home in Dunedin. (5)

As the next information is dated September 1875 and relates to Edward's experience for 'nearly two years' (6) in the engineering works and drawing office of Messrs Miller and Herbert, Edinburgh, Scotland, it seems likely that he left New Zealand for the United Kingdom soon after leaving school and thus commenced his engineering training before his fifteenth birthday.

Barton's obituary (7) and an entry in *Who's Who in Engineering* (8) both refer to technical education at Otago University but consideration of the established dates in the present account shows that there must be an error in this claim; his name does not appear in the student or graduate lists of the University. (9)

In October 1875 Barton enrolled at Karlsruhe Polytechnic Institute in Germany and

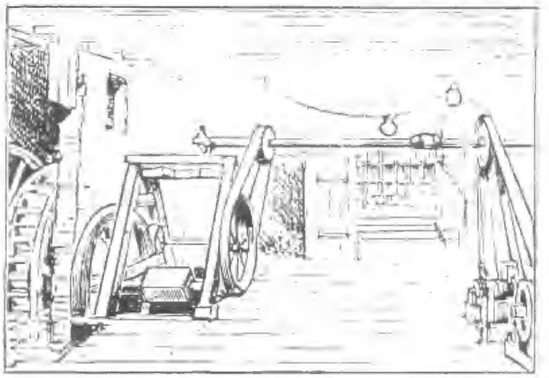

FIG. 2. First electric lighting plant at Godalming, Surrey, England. A water-wheel powered by the River Wey was used to drive a Siemens Bros generating plant installed in the leather mills of Messrs Pullman and Co. in September 1881.

commenced a four year course in engineering which finished in July 1879. (10,11) Appendix A gives the main features of the course showing that mechanical engineering topics predominated in the later years. Electrical engineering is not mentioned as such even though telegraph systems were well established and early forms of dynamos and motors in use. It is a tribute to Barton's ability that he was able to undertake such a course requiring fluency in a foreign language and the use of an unfamiliar system of measurements.

Sometime after completing the course he evidently visited the U.S.A. because according to a certificate from the Street Commissioner and Road Overseer of Neasho Falls, Kansas dated 12 July 1880 he 'worked for two days on the Streets. . . said labor being in full for his poll-tax for the current year.' (12)

Later in 1880 he returned to the Edinburgh engineering works that had employed him previously, the name of the firm having changed meanwhile to Herbert and Law. He resigned in late September 1881 and no doubt was present at his sister's wedding in London on 5 October.

In December 1881, aged 23 years, Barton was appointed an Assistant in the Electric Light Department of Siemens Brothers and Co. Ltd, a leading electrical engineering firm in London. In this capacity he 'erected and ran several installations for the firm one being of 200 incandescent and six arc lights for the Royal Academy, Burlington House, London and ran it for several months.' (13) He was then transferred to the small village of Godalming, Surrey to 'superintend the establishment and

maintenance of electric lights' (14) as Siemens had contracted to take over the installation from 1 May 1882. The background to this was that a water-wheel driven Siemens alternator with a separately driven exciter had been set up on behalf of the local Council by Messrs Calder and Barrett — a small firm of London electricians — using water from the River Wey. (Fig. 2) The alternator supplied about 4 kW at two voltages. (Fig. 3) The thirty or so Swan incandescent lamps received 40 volts and the seven Siemens arc lights in series, 250 volts. On 26 September 1881 the upper portion of the Borough was 'lit by electricity for a few hours as an experiment and continued each night since.' (15) The sets of incandescent lamps and arc lights were each supplied by means of a single conductor-earth return system. The wires were bare and supported on telephone insulators. (16)

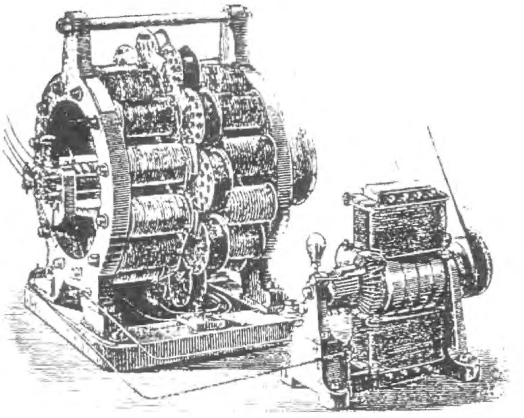

FIG. 3. Siemens Bros dual-voltage alternator and separate exciter, probably similar to the plant installed at Godalming in 1881. Both machines were belt driven through a countershaft as indicated in Fig. 2.

> The new installation was a pioneering one in many respects not least in its first use of water power for a significantly sized power scheme, an important development but one that pales into insignificance however beside the real departure achieved at Godalming which was the use of the street lighting supply to power directly electric lights in local private houses. In other words Godalming was the world's first public electricity supply scheme and although not more than a few private homes were ever lit by means of the public supply it proved at the time of its opening that such a scheme was a fully practical proposition. Consequently it is from the late 1881 opening of the Godalming scheme that the history of electricity supply really dates. (17)

The effect of a 300 candle power arc light in the Godalming High Street (Fig. 4) was described as

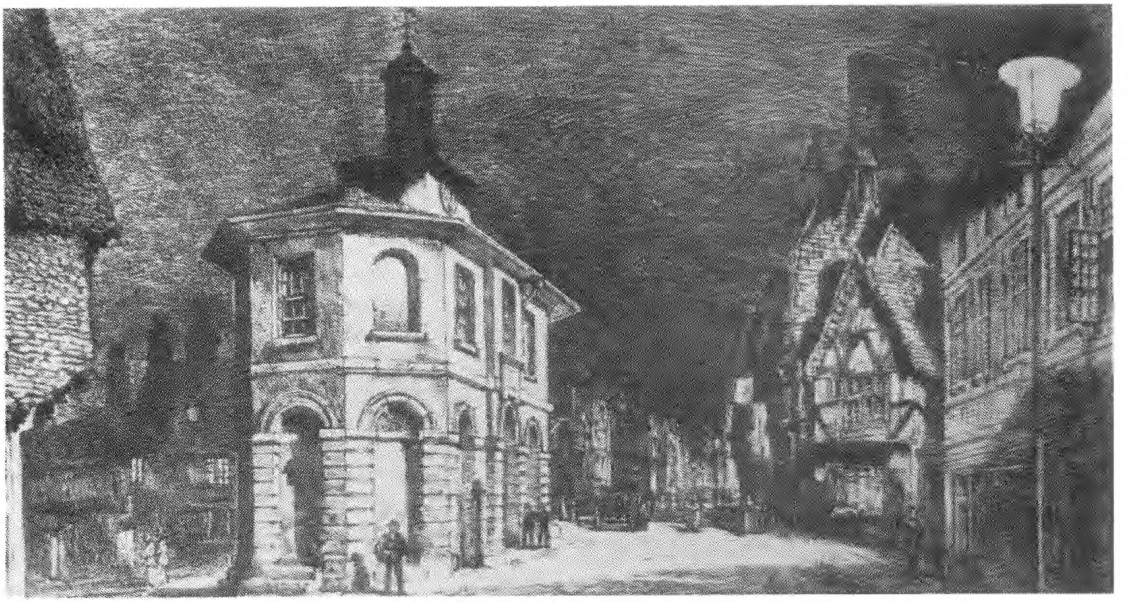

FIG. 4. The High Street of Godalming illuminated by arc lights in September 1881. The generating plant provided both public and private electricity supply and this was said to be the first town in the world with these services.

'strangely theatrical with a picturesque contrast of light and shadow.'(15)

But all was not going smoothly; there was conflict with the local gas company which was already well established and which in the face of competition reduced the price of its services. Further there were problems caused by the failure of the water-wheel to provide enough power and by inadequate conductor size. There is a reference to the use of a steam engine (Fig. 5) as an auxiliary source of power and this was probably the situation when Barton was sent to Godalming in an attempt to restore confidence in the electric lighting of the village.

It should also be noted that incandescent lamps were still in a very early stage of development as is evident from the following extract from the 1883 catalogue of the Company supplying the lamps — Messrs Swan United Electric Light Co. of London. This refers to the lamps used at Godalming and later in Brisbane. (18) (Fig. 6) The phrase 'subdividing the electric current' (also expressed as 'subdividing the electric light') refers to the distinction between arc lighting — which was excessively brilliant for domestic purposes — and the newly developed incandescent lamp lighting —

The difficulty of subdividing the electric current for the economical production of incandescent light, which, till recently, has completely prevented the introduction of electricity for lighting purposes, has been satisfactorily solved by the invention of the SWAN INCANDESCENT LAMP. By its means separate lights of various powers, applicable to all the ordinary uses of gas burners, and to all the purposes for which artificial light is required, can be produced.

The SWAN INCANDESCENT LAMP is extremely simple in its construction, and may be described as follows:- A small glass globe from which all the air has been exhausted, and in which is fixed a thin filament of carbon connected with two platinum conducting wires, which pass through and are fused into the glass. On passing the electric current through the carbon it becomes intensely white hot and emits a beautifully soft, clear, and steady light. As the carbon is not in contact with the air there is no combustion, and, therefore, no deterioration of the atmosphere of the room in which it is used, and exceedingly little heat is given off. This lamp, unlike most other electric lamps, has no mechanism about it, and when it fails, from use or accidental breakage, it is as easily replaced by a new one as a candle is placed in a candlestick. The light given out by the ordinary SWAN INCANDESCENT LAMP is 20 candle-power, but lamps are now in use varying from 2½ to 100 candle-power each. . .

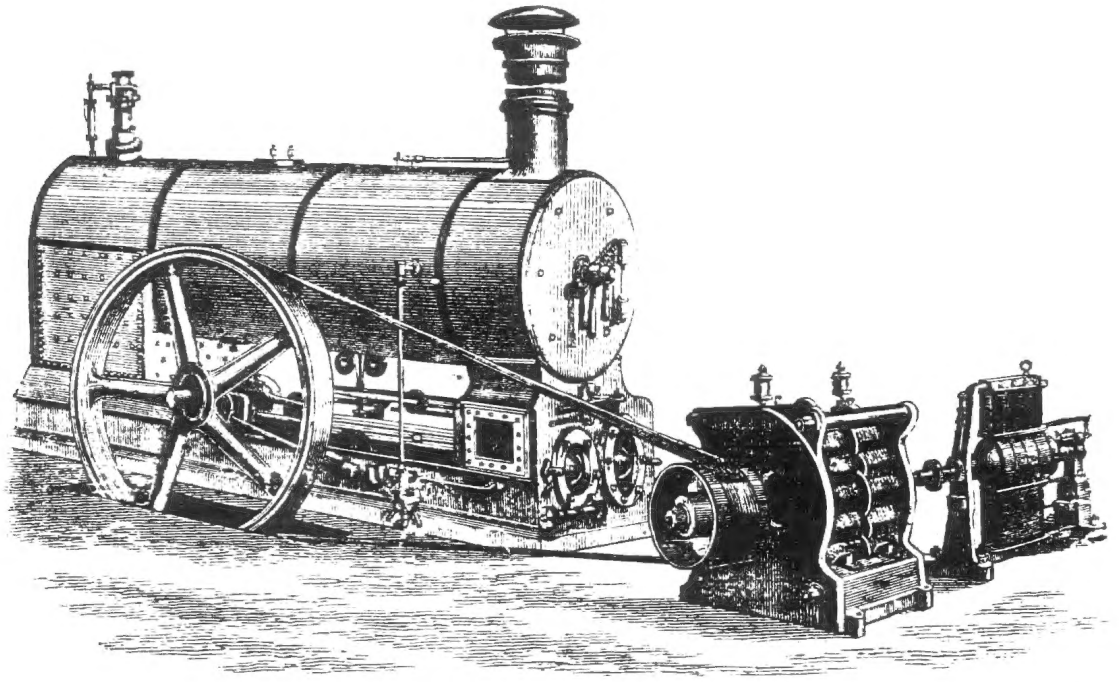

FIG. 5. Semi-portable steam engine driving an alternator with direct coupled exciter, probably similar to the auxiliary electric lighting plant at Godalming, supervised by Barton in 1882.

Further problems arose at Godalming including the introduction of restrictive legislation, and by April 1884 Siemens Bros withdrew. So a fascinating and well recorded experiment ended and it was not until 1897 that the streets were again lit by electricity.

Barton returned to London five months after his appointment to Godalming and resigned from the Company. His last recorded work in England was the erection of 12 arc lamps and 40 incandescent lamps at the Midland Railway Station, Derby — presumably while employed by Siemens Bros. (13)

A month or two after Barton's appointment to the staff of Siemens Bros, Holborn Viaduct, London saw the inauguration of the world's first electricity supply scheme built according to the Edison system, at the time by far the most advanced and well-thought-out approach to electric lighting yet developed. The steam-driven Holborn Viaduct installation, the first 'central station' in Britain to use steam power, was not only technologically far in advance of its contemporaries, but was also on a much larger scale. (17) Either of the two Edison 'Jumbo' dynamos each direct-coupled to a steam engine, could supply over 1000 incandescent lamps each of 16 c.p. (19) (Fig. 7) No doubt Barton visited the station while working in London and found the details of great interest, little thinking that a few years later he would be in charge of an Edison system power plant in the Antipodes.

In a letter dated 24 August 1882 for Barton to use as a reference, Siemens Bros wrote —

> We have been perfectly satisfied with the manner in which he has carried out his work in every respect and may add that he is leaving us at his own desire for the purpose of returning to New Zealand. (14)

Barton was asked to carry out some commissions for the firm there and a letter from them to a Dr Lemon of Wellington said

> It would be of great satisfaction to Mr Barton if he could be entrusted with the fitting up of the Houses of Parliament or other public buildings with electric light which we are sure his experience would enable him to do to the satisfaction of your Government. (14)

Later, Barton in describing his earlier employment referred to —

> Dr Lemon of New Zealand to whom I came out from Messrs Siemens Bros. (20)

Edward Barton left England for New Zealand sometime after early October 1882 and

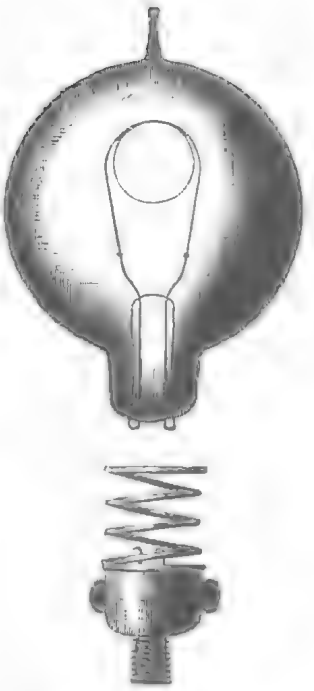

FIG. 6. Carbon filament incandescent lamp manufactured by the Swan United Electric Light Co., Ltd in 1881. The luminous efficiency was about 4 watts per candle power. This consumption was halved some 30 years later when metal filament lamps were marketed. The lamps at Godalming were supplied with 40 volts, alternating current.

so, when about 24 years of age, commenced a span of over thirty years of dedication to electrical engineering and particularly to the electricity supply industry.

EARLY ELECTRICAL ENGINEERING WORK IN AUSTRALASIA

NEW ZEALAND

The date of Edward's return to New Zealand has not been found but presumably it was late in 1882 or early in 1883. In New Zealand, according to N.M. Speer, (21) early flour mills in Canterbury Province were supplied with electricity produced from water power and the range of dates quoted (1860–80) suggests that this preceded the period when incandescent lamps were available commercially. Even the earlier form of lighting by arc lamps would have been rare in the late 1870's.

Records of the 1880's give two versions of

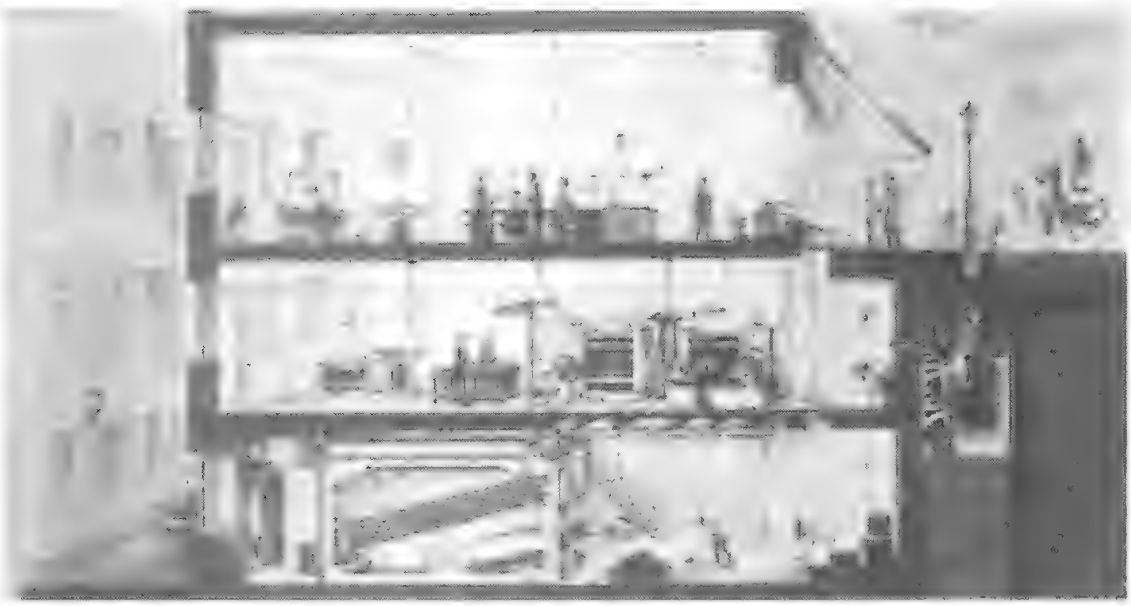

FIG. 7 Artist's reconstruction of Holborn Viaduct, London power station built in 1882. The capacity of the station was over 2000 16 c.p. lamps. Each Edison 'Jumbo' dynamo generated 110 V. d.c. and was driven by a Porter–Allen high-speed steam engine supplied from a Babcock and Wilcox water-tube boiler in the sub-basement. The combined weight of each engine-dynamo set was 8 tons.

'the first house in New Zealand to be lit by electricity.' Speer credits a Mr Moss Davies of Auckland with this distinction in 1882, while the *Waikato Times* gives precedence to Dr Lemon, Superintendent of Telegraphs, having his home in Wellington lit in May 1883. (22) The latter is of special interest because Edward Barton had been given an introduction by Siemens Bros. to a Dr Lemon in New Zealand. References to 'Dr Lemon' are apparently to the same person and Barton may have helped with the installation as the equipment was supplied by his previous employer and he would have been very familiar with it. The generator was driven by a gas engine and had a capacity of 15 lights of 20 c.p. each.

In view of the comments by Siemens Bros regarding Barton's capabilities, it is of interest to find his name in a Parliamentary Report dated 10 August 1883 which lists him as employed in connection with the lighting of the Houses of Parliament in Wellington from 11 July 1883 for an intended period of eight weeks. What his duties were is not shown but his name is included in a financial statement under 'Estimated Liabilities to the end of the Session.' (23) This appointment was presumably that referred to in the summary that Barton gave of his work in New Zealand in his second application in 1886 for the position of Queensland Government Electrician. It showed that he 'fitted the following installations; one of 180 incandescent lamps, one of 6 arc lights; one of 60 incandescent lamps.' (24)

It is possible that, apart from an understandable wish to revisit Dunedin, Barton may have been attracted to New Zealand by hearing of the report in the *Waikato Times* of 24 June 1882 that consideration was being given to establishing in Wellington a company with a planned capital of £200,000 for the purpose of supplying public and private lighting by electricity. There were to be directorates in Auckland, Canterbury and Dunedin. The idea was probably ahead of its time as was a similar one advertised in Brisbane in December 1882 by the Queensland Electric Light and Power Co. Ltd with a planned capital of £100,000. (25)

A letter from his father, then living in Sydney, provided this comment on Edward's activities in New Zealand up to March 1884 —

> We have just received your letter of 12 March in which you express fears of the Brush Co. bursting up and discuss the question of what you ought to do. I think your reasons for leaving New Zealand are rather odd ones but no doubt if your increased intimacy with the Otago nobility only increases your expenses without getting you their 'boiler making' you would be right to leave the place. (26)

The reference to the 'Brush Co.' in George Barton's letter should probably read Australasian Electric Light, Power and Storage Co. Ltd (AELP&SCo.Ltd) which was one of the many subsidiaries of the London based Anglo-American Brush Electric Light Corporation. This comment is based on a letter from the Brisbane branch of AELP&SCo.Ltd dated 27 August 1886 which referred to Barton's three years of service as an 'electrician' to this company. (27) If the three years is taken literally, Barton was engaged by the company while in New Zealand about the time of the electric lighting of the N.Z. Parliament buildings. Thus his decision to come to Australia, made soon after his father's letter was received, would not have required his resignation. The picture is confused by an entry in *Who's Who in Engineering* (8) which was presumably agreed to by Barton himself. This lists under 'professional training' — 'New Zealand Electric Light Co(NZ); Brush Co. (Queensland)". The former company has not been identified.

George Barton's reference to 'bursting up' of the Brush Co. was probably based on the disastrous change in the fortunes of the parent company in England. Their equipment sales for 1881 amounted to £80,000, and in 1882 to £200,000 but these dropped to £35,000 in 1883. This sudden decline was generally attributed to the conditions imposed on the embryo electric lighting industry in England by the Electric Lighting Act of 1882. (17)

Australia

Progress in Electric Lighting to 1884:

Barton left New Zealand in mid-May 1884 as a saloon passenger aboard the *Arawata* and arrived in Melbourne on 22 May. (29) Presumably his return to Australia was in the expectation of better prospects of employment in electric lighting work. Just what these prospects were can be best imagined from the following outline of the developments prior to his arrival.

Arc lighting with batteries as a source of power had been demonstrated in Melbourne in 1867 but this was regarded as a novelty with no commercial application. In 1877 a dynamo was used to supply arc lights in a Melbourne factory and in 1880 the Melbourne City Council licensed a private company to light up the Eastern Market with arcs using, incidentally, one dynamo for each lamp. Still earlier, in 1863, an arc light had been mounted on Observatory Hill, Sydney to celebrate a royal marriage, but the first lighting with a dynamo was in 1878 to illuminate night-time construction in Sydney's Domain. Incandescent lighting was introduced in Sydney with equipment imported in 1882. (30)

In Brisbane the first arc light was set up as a display outside the Telegraph Office in William St, near Elizabeth St, on 1 July 1878. The equipment was actually purchased for the temporary defence installation at Parker's Island (in the vicinity of the Brisbane suburb of Eagle Farm) so that 'the approach of boats at night in the vicinity of the torpedo station may be observable.' (31) The current was supplied by a battery of primary cells. While this was reported as the first electric light yet tried in Queensland, there is a record in the minutes of the Queensland Philosophical Society that, at a conversazione held in Brisbane on 29 June 1878, 'the electric light was exhibited'; unfortunately there is no further information.

Omitting any mention of these reports, F.R. L'Estrange (32) stated that —

> the earliest use of electricity in Brisbane was at the end of 1881 or the beginning of 1882 shortly after the Edison Company commercialised their incandescent lamp. Mr Kingsbury of Sydney visited us about this time. He was the NSW agent and imported some Edison generators, bamboo filament lamps, wires and accessories. Alfred Shaw's of Brisbane were Edison's Queensland agents. Mr T.E. White (Manager of Alfred Shaw and Co.) quickly acted and took the opportunity of acquiring a generator and fittings and it was installed in Sutton's foundry at the corner of Adelaide St and Foundry Lane (now Isles Lane). (Figs 8,9) It was utilised for lighting in the foundry. . . and an extension was made across the swamp to Smith's tinsmith shop, up towards Queen St (probably to help them with work that he did for them). It would appear that this generator was used for further extensions, one being for the lamp lighting on 9 December 1882) (33–35)

The event of 9 December was the illumination of Queen St by eight arc lamps but L'Estrange was almost certainly mistaken in reporting that Sutton's generator appeared to have been used for these lamps. Apart from the requirement that about 300 volts would have been needed as compared with 110 volts for incandescent lamps, it is reasonable to suppose that the Brush Co, which had organised the demonstration would provide its own equipment. Further the Edison and Brush companies were in direct competition at this


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time. The arc-lamp generator ('dynamo machine') would probably have been similar to that shown in Fig. 10 and since Sutton was a very interested party to the display no doubt he would have willingly provided power from the steam engine driving his own generator.

The following extracts from newspaper reports show the manner in which the Press of the period provided technical details in addition to describing the evident astonishment of the public —

> The Brush system of electric lighting will be illustrated in Queen St this evening by eight arc lights between the corner of Eagle St and the Bridge. (Fig. 11)
>
> The electricity is generated by a dynamo machine placed in the large shed in Adelaide St nearly opposite the Girls' School, and occupied by J.W. Sutton and Co. From this point a conducting cable composed of seven strand No.16 wire carefully insulated, conveys the current the whole length of Queen St, all the lamps being in the same circuit. The dynamo machine is driven by a 10 h.p. Robey and Co. steam engine at a speed of 700 to 1000 revolutions per minute, and this supplied the current required for the whole circuit. The lamps are erected on cast iron standards some 20 ft in height. The light is produced by the spark given out when the electric fluid passes from one to another of two carbon points in contact. The whole mechanism of the lamp, therefore, is directed to maintaining the two carbon rods in contact. There are two of these placed vertically in the lamp, the lower one fixed and the upper one so controlled by the apparatus that it gradually slides down as the point becomes consumed. This is activated by gravity alone, while it is controlled solely by the influence upon a bar of iron of a magnetic field, the intensity of which varies with the strength of the electric current passing through the lamp circuit. The carbon rods are one foot in length, and are electroplated with a thin coating of copper. They last about eight hours, during which time 9½ in. of the positive and 4 in. of the negative carbon are consumed. The lamps erected in Queen St are made to burn 16 hours without attention, as by an automatic arrangement as soon as one set of carbon is consumed the current is directed through a second set. The mere hanging of the lamp in its place puts it in circuit, while the extinction of one or more lamps, or indeed their

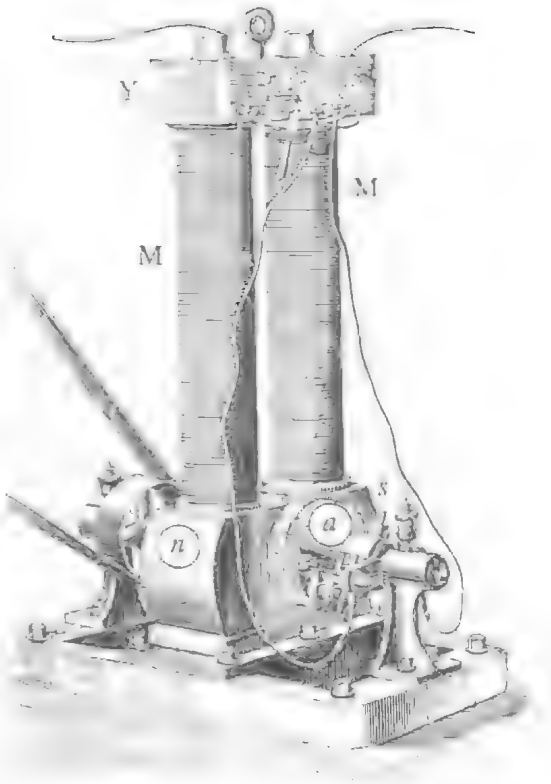


FIG. 9. Probable type of belt-driven bi-polar dynamo as supplied in about 1882 to J.W. Sutton of Brisbane. The capacity of the dynamo was described as 60-light (about 5 kW). The basic electrical and magnetic components are marked thus: *a* armature with commutator and brush gear, M M electromagnets joined by a yoke Y at the top and carrying pole pieces *n* and *s* at the level of the armature. The long electromagnets led to the description of the equipment as 'long waisted Mary Ann'.

FIG. 8. Map of Brisbane dated 1893 with locations of electric power plants, 1882 to 1911. 1, Sutton's Foundry, corner of Adelaide St and Isles Lane (previously Foundry Lane). Plant at this site provided supply for the demonstration of arc lighting in Queen St in 1882. 2, Queensland Government Printing Office. Supply was given to part of the Printing Office in 1883. In 1886 a new plant supplied both the Printing Office and the Parliamentary buildings. 3, Brisbane Newspaper Co. Office, corner of Queen and Edward Sts, 1884. 4, Queensland Government Railways, Roma St Yards. The arc lighting was supplied from plant located between the Railway Station and the Normanby Tunnel in 1884. 5, Barton, White and Co., electricians, Telegraph (later Edison) Lane, 1888. Commercial supply was given to the Queen St area initially. The company was renamed Barton and White in 1892 and, after reforming, Brisbane Electric Supply Co. Ltd in 1896. 6, Brisbane Tramways Co. Ltd, Countess St. This station supplied power for electric trams in 1897. 7, Brisbane Electric Supply Co. Ltd, Ann St, 1899. The company was renamed City Electric Light Co. Ltd in 1904. 8, City Electric Light Co. Ltd, William St, 1911.

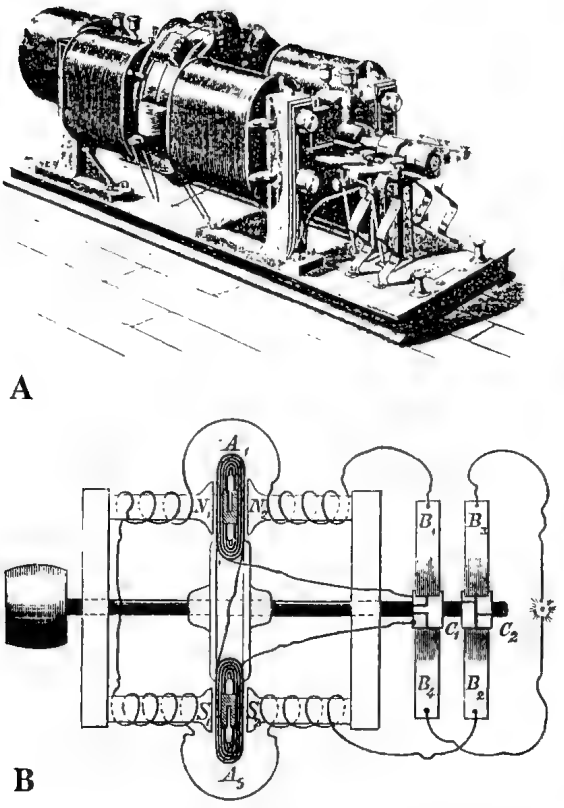


FIG. 10. **A**, the Brush Co. 16 light dynamo for arc lighting. Two were installed near the Roma St Railway Station in 1884. They were driven by a steam engine, each requiring about 15 h.p. **B**, electrical diagram showing the principle of operation of the dynamo. There are eight armature coils (of which two marked A1 and A5 are shown) grouped in two sets connected to commutators C1 and C2 respectively. The field windings comprise four helixes in series.

> removal, does not affect the others. The lamps are enclosed in globes of semi-transparent glass, which are surrounded by a cover of tin to keep out the dust. (25)

The demonstration was duly given and reported on as follows —

> After the first sensation of surprise was over, numbers of people stood in groups at the foot of the lamp posts, apparently enjoying the beautiful light, and there was but one expression — that of unqualified admiration — to be heard on all sides, the high expectations formed by those who hitherto had only read of the electric light being fully met. To those who watched closely there was apparent a very sensible variation in the intensity of the light, although there was nothing approaching to the flickering motion so noticeable in some forms of electric light. (36)

About a fortnight after the display, Christmas decorations were provided by incandescent lighting in the shop windows of Messrs Finney, Isles and Co. and 10 or 11 arc lamps were arranged outside various shop windows. (37) If the two generators necessary to cater for the two forms of lighting were both in Sutton's premises, he could reasonably have claimed to be the first in Brisbane to have provided electricity supply — albeit briefly — for a street and shop simultaneously.

It was no coincidence that on 9 December 1882, the same day as the Queen St display the *Brisbane Courier* carried an advertisement proposing the setting up of a public company — the Queensland Electric Light and Power Co. Ltd — to provide electricity. The stated aim was —

> to supply within the colony of Queensland the quick and rapidly increasing demand for

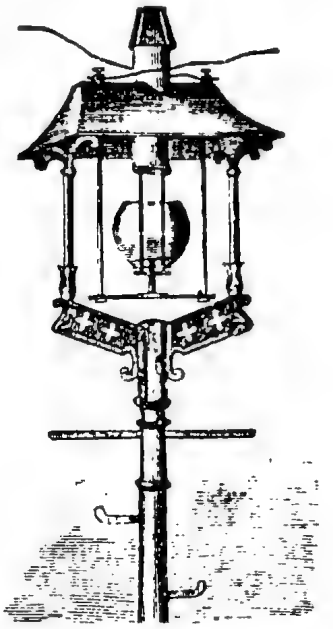


FIG. 11. Carbon arc street lamp manufactured by the Brush Co., London in the 1880's. The carbon electrodes were arranged in pairs and connected in series. The regulating mechanism above the electrodes allowed the arcs to be struck and the spacing adjusted as the electrodes burned away. The street lamps were connected in series to the electricity supply. Eight of probably similar design were used to light Queen St, Brisbane in December 1882.

ELECTRICITY in its various applications to Light, Motive Power, and other applications. It is intended to erect in suitable centres, depots for generating Electricity, and to supply it to all classes of customers, either direct from dynamos or from storage or secondary batteries, for use either in arc or incandescent lighting, or as motive power for driving machines. . .

In conclusion came the assertion that —

the vast field of profitable operations in store for the present Company will be recognised. (25)

Initially 30,000 of the total of 100,000 £1 shares were to be offered to the public while the vendors of the patent systems were to receive 30,000 fully paid up shares and £6000 in cash. After two such advertisements nothing further appeared about this company and it can be safely assumed that it did not evoke public interest in spite of the impressive list of Directors, a detailed description of the 'patent systems' and a forecast of the future of electric lighting given a few days later. (38) The Directors were to be: Hon. John Douglas, CMG, a former Premier of Queensland; Hon. B.D. Morehead, MLC, Postmaster General; Robert Porter, JP, Mayor of Brisbane and J.W. Sutton, Sutton's Foundry.

In April 1883 the Queensland Government Printing Office in William St introduced incandescent lighting. It was reported that 70 to 80 people assembled in the Office to witness the lighting by 'Edison Electric Light', there being 'some 50 Edison burners (20 equal to 8 candles, 30 to 16 candles and one of 32 candle power) supplied by an 8½ h.p. dynamo driven by an engine used for the printing machinery.' (39) The term 'burners' (to correspond with the familiar gas burners) referred to Edison's carbon filament lamps.

No doubt impressed by the success of the electric lighting in the Printing Office, the Brisbane Newspaper Co. followed suit by installing its first lighting plant in March 1884. The contract was placed with the local agents for the Australasian Electric Light, Power and Storage Co. Ltd (AELP&SCo). The *Brisbane Courier* published the following account of the first trial —

Forty-three of the Lane-Fox incandescent lamps have been hung in the composing room, and the electric current is supplied by a Victoria Brush dynamo machine, which runs at the rate of about 750 revolutions to the minute, and which is driven by a 6 horse power horizontal steam engine. The lamps burned with great steadiness, and gave an extremely bright yet soft light. The eyes of the compositors were protected by means of shades, and at the same time the light was distributed over the 'cases', and in fact over the whole room, with extreme evenness, while no shadows were cast, as is the case when gas is burning. The workmen expressed themselves as greatly pleased with the new light, which may so far be pronounced in every way a success. (40)

A few months later the lighting was extended to 100 lights, the work being carried out by Mr G.D. Hamilton of AELP&SCo. (41)

Even before the Brisbane Newspaper Co. had their plant in operation, the Queensland Government Railways had decided to have arc lighting at Brisbane (later Roma St) station. In January 1884 a contract was let for the building of an electric light machinery shed for the sum of £276. The area was approximately 1000 sq. ft and the shed was located immediately west of the north bound railway line and some 260 yards south of the Normanby Tunnel. In October 1884 a contract was let for 'Lighting Brisbane Station with Electric Light' for the sum of £1259, requiring the supply of ten 'Brush' arc lamps supplied by 'sixteen lamp Brush' machines. (42) The total cost is assumed to have been £2034 as shown against this installation in the Annual Report of the Railways Department. This was the year in which the first such installation in Victoria was built in Melbourne where the requirement was for better lighting in the Spencer St goods and passenger railway yards in order to make less dangerous the hazardous occupation of train shunting, as well as to deal with the rapidly increasing traffic. The Melbourne installation comprised a portable 'Robey' steam engine driving by belt and countershaft two 'Brush' 50-light arc lighting dynamos. (43) The Roma St equipment was of smaller capacity but probably otherwise similar.

Thus there were at least four generating plants in operation by 1884.

FIRST WORK IN AUSTRALIA: There is little doubt that Barton travelled extensively in eastern Australia after his arrival in Melbourne in May 1884 but there is no clear record of his professional work for the first eighteen months or so. A family letter dated 11 June 1884 shows that by then he had been in Sydney and had gone to Gympie, Queensland and, as he was retained by AELP&SCo., the visit to Gympie may have been on their behalf. It is believed that he installed a dynamo at the Phoenix gold mine there in 1885 and as the Mining Warden's report for the year states that 'the Phoenix P.C.

mine is lighted on the surface by electric light' this is probably the same installation. (44,45) One purpose would be to light the areas around the crushing mills thus permitting longer hours of operation.

The work for AELP&SCo which was evidently on a part-time basis ceased about 27 August 1886 because on this date the firm's Queensland agents gave the following reference —

> During the past three years we have every reason to be pleased with your services and only regret that there is not sufficient opening in Electric Lighting to enable us to retain them. (27)

In giving evidence to a Parliamentary Committee of Enquiry in Brisbane in 1886 Barton stated that in addition to his English experience he had 'erected and run both arc and incandescent plant in New Zealand, Tasmania, Victoria, New South Wales and Queensland' for AELP&SCo and had superintended the installation of the electric lighting system in Parliament House Brisbane. (13)

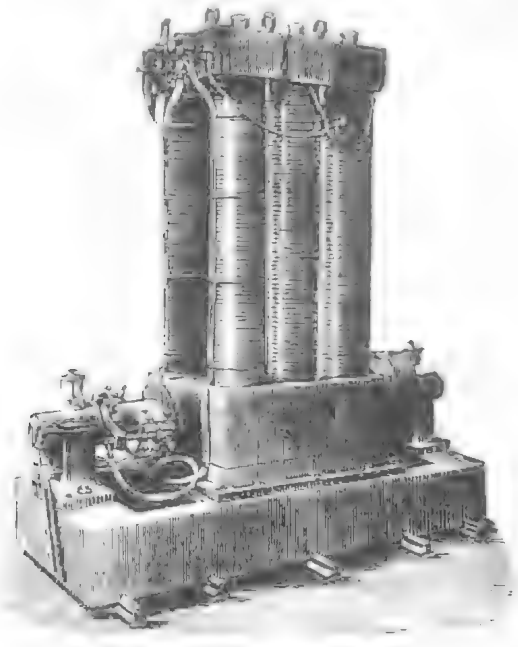


FIG. 12. Edison Co., USA, dynamo type K of 250 light capacity. Two of these were ordered by the Queensland Government from the Edison Co. in 1883. Those delivered were type H of 400 light capacity and are believed to have been of similar appearance. They were installed in a new building adjacent to the old Queensland Government Printing Office in 1886. (Fig. 14)

In a letter dated 5 March 1886 Barton applied for the position of Queensland Government Electrician and described his experience as including '18 months in Brisbane doing electrical work, and can refer to Mr Starke.' Henry Starke was appointed in 1880 as an Instrument Fitter in the Post and Telegraph Department, Brisbane and was responsible for installing the original Telephone Exchange there. In his second application for the Electrician position dated 22 April 1886 Barton mentioned only two small electric lighting installations in Queensland as his responsibility there since about September 1884 and no other reference to his work in Brisbane has been found elsewhere. Hence it seems likely that he was engaged in telephone work about this time. (20,24) He detailed other Australian experience with AELP&SCo. as follows — N.S.W., one installation of 25 incandescent lamps; Tasmania, one installation of 16 arc lamps and one installation of 100 incandescent lamps. He does not refer to any work in Victoria in spite of his mention of this at the Enquiry.

Barton interested himself in at least two other ventures. In 1884 he and his father, who took the most detailed and almost overwhelming interest in his son's activities, investigated the possibilities of paper bag manufacture, apparently in Sydney. (46) A proposal to market lubricators said to have been patented by Barton was also investigated in the same year and it is believed that some were sold in Brisbane. (47) However nothing definite is known about the outcome of either scheme.

ELECTRIC LIGHTING OF THE PARLIAMENTARY BUILDINGS, BRISBANE: The first well documented information about Barton's professional engineering work in Brisbane is in connection with the electric lighting of the Houses of Parliament and the Government Printing Office. In particular, he featured prominently in an enquiry into a fire in the House of Assembly in 1886 which was the subject of a lengthy Parliamentary Report described as 'Accident to the Electric Light'. (13)

A contract for the lighting had been let in April 1883 to 'Edison's Indian and Colonial Electric Co. Ltd' based on a very brief specification provided by the Company describing the electrical plant and giving the number of lights to be installed. The two

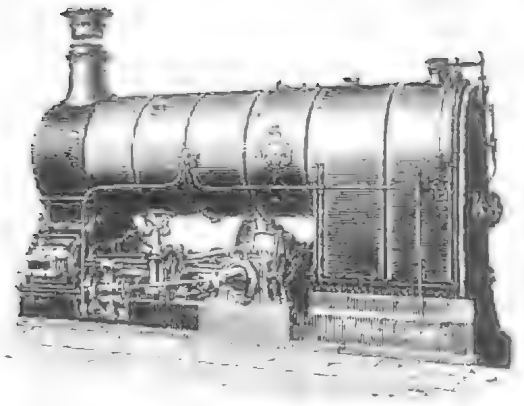


FIG. 13. Robey and Co. compound steam engine with locomotive type boiler probably similar to the engines supplied to the Queensland Government Printing Office in 1884. Delays in the construction of the building and in installing the electric lighting prevented operation of the engines until mid-1886.

dynamos ordered were described as 'Edison K 250 light, 16 c.p.' (Fig. 12) but it is clear from the Parliamentary Report on the fire that each of the dynamos had a capacity of 400 lights and this is confirmed by their designation as H19 and H20 respectively, H being the Edison Co.'s symbol for the 400 light rating. (48,49)

It seems to have been implicit in the scheme that slow-speed steam engines would be ordered and that an extensive pulley and belting system would be provided to give a several times increase in speed for the dynamos. The tender for the engines and boilers followed in May 1883 but was not accepted. Presumably because the steam plant and dynamos were to be housed at the Government Printing Office and part of the output used by this Office, the Government Printer was consulted and he recommended that an order be placed with Messrs Smellie and Co. of Brisbane for two 40 h.p. Robey steam engines with locomotive type boilers. (Fig. 13) This was agreed to in June 1883. Later the Edison Co. agents (Messrs Alfred Shaw and Co., Ltd) were asked to tender for an extension of the original contract to include the Legislative Council Chambers and their tender was accepted in December 1884. It is of interest to note that the lighting system was based generally on the provision of 'one 16 candle-power lamp for every gas jet.' (48)

The most pressing need was to plan a building adjacent to the Government Printing Office to house the power plant. No photograph of the layout has been found but using the original drawings and information about the machinery a reconstruction has been attempted as shown in Fig. 14. For comparison a German power station of the same period is shown in Fig. 15 and although the height of the poles of the dynamos indicate a slightly earlier design the difference in the space taken up by the belt drives is obvious. Possibly this is due to the German plant using higher engine speeds than the Brisbane plant. No doubt because of its size the construction of the building was much delayed and the overseas plant, delivered in 1884, remained in store for almost two years.

As well as the complaints about the progress with the building, there was considerable dissatisfaction with the way the lighting installation work was being carried out. In March 1886 the Edison Co. agents (Messrs Alfred Shaw and Co.) requested Mr Kingsbury who represented the Edison Co. in NSW to report on the situation. The following extracts from his report (50) show the state of the installation work at that time —

> . . . Had the running of the conductors, the general work of fixing lamps and the necessary technical details throughout the installation been supervised by an ordinarily competent expert there would have been no further necessity for my presence. On sending the current through the circuit however the astonishing amount of earth leakage and the evidence of a short circuit at my first test proved the necessity for the taking of immediate steps to localise and eliminate these faults, dangerous alike to the buildings and the machinery. . . What remains now to be done before you have your official trial and hand the installation over to the Government can well be carried out by Mr Barton whom I have fully informed as to running the additional cable and placing safety blocks and switches that I am sending him. . .'

From then on it is clear that Barton was a key person, described as Messrs Alfred Shaw and Co's electrical engineer.

At least some of the work that was so strongly criticised by Kingsbury was carried out by the Government Electrician, James Mathieson, who prior to this appointment in July 1885 was employed by Messrs Alfred Shaw and Co. Mathieson was asked to continue the installation work after his Government appointment at least until September 1885; it is believed that this arrangement followed the death of the Edison Co. engineer, Mr Snow.

The Colonial Secretary was informed of the adverse report and then requested Mr A.E.

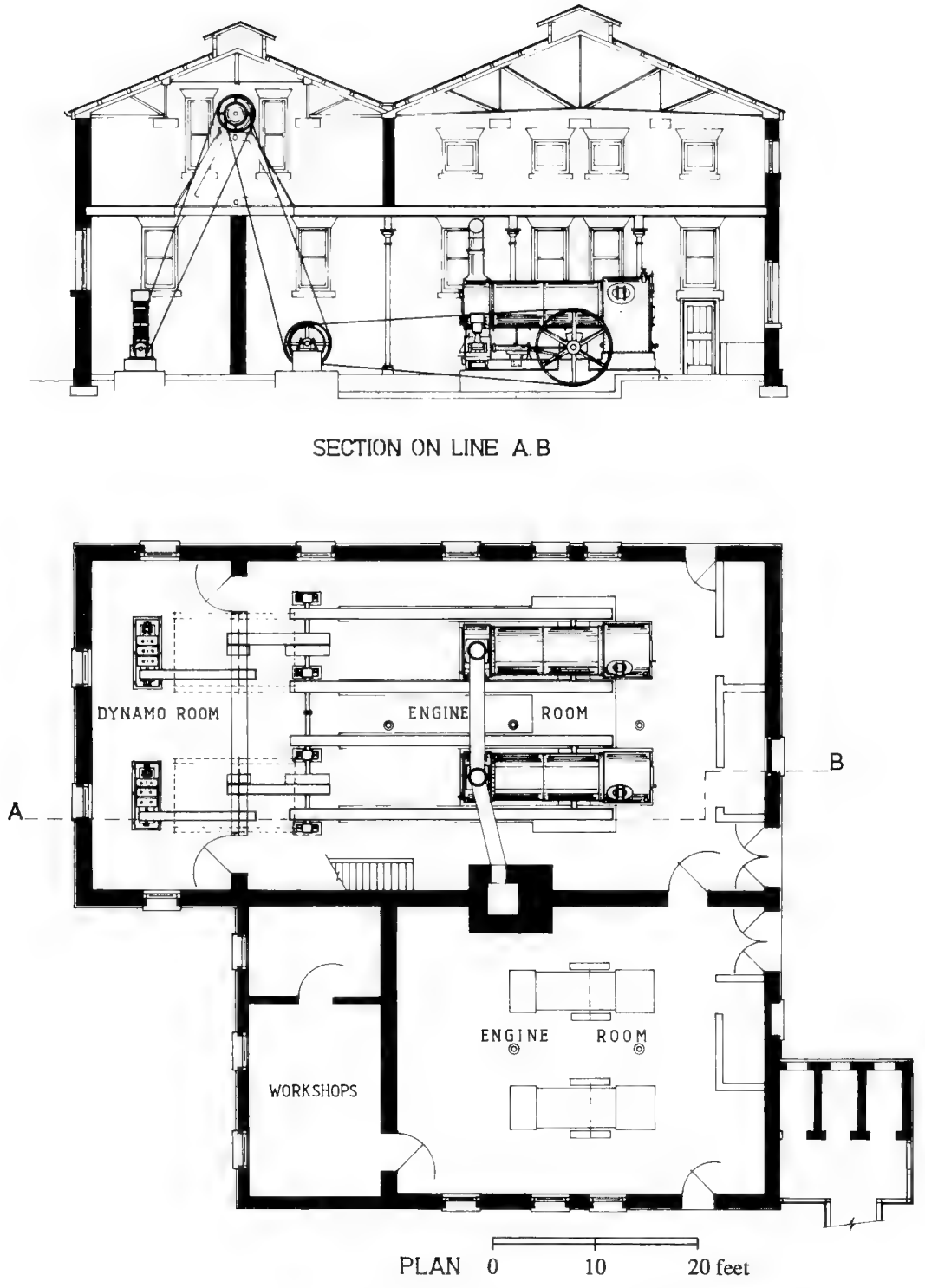


FIG. 14. Layout of the Queensland Government Printing Office power plant building, 1886 based on archival data. It was adjacent to the Printing Office between George and William Sts and supplied electricity for lighting the Parliamentary buildings and the Printing Office.

Matveieff, Superintendent of Telegraphs for Queensland, to investigate the matter. His report dated 28 May 1886 was also very critical of the work by Mathieson. (51) During the enquiry Barton gave evidence that he had been employed for the previous two months remedying the defects referred to in Mr Kingsbury's report.

The result of Matveieff's report was the resignation of Mathieson after about a year's service as the first Queensland Government Electrician and it is clear that Barton was in charge of the installation work until early July 1886 when it was handed over to Mathieson's successor, Thomas Tomlinson, BA,BEng (Dublin). Tomlinson had been a draftsman in the Department of Harbours and Rivers and was a Captain (Prov.) in the Defence Forces, Brisbane Engineers. (52) His academic record must have impressed the Government as Barton's application for the same position showed far wider experience with electric lighting and was supported by the Government Printer, J.C. Beal. (20)

Meanwhile the steam engines and generating plant had been installed. The mains — described as 'Edison Street Tubes' — that were required to connect the generating plant to the Parliamentary buildings had been mentioned in the original contract but the price had not been stated. There must have been an agreement by the Colonial Secretary to incur the extra expense but the only record is an invoice dated 15 August 1884 for the supply of 79 lengths of tubing (mostly 20 ft) and accessories for about £500. (53) The route was along William St (Fig. 16) and approval for the necessary excavation was obtained from the Municipal Council in April 1884. A contract was then placed for the trenching work and as this was to be completed by 11 June it is safe to assume that the mains were laid by this time. (54) The depth of laying was less than one foot below the road surface and this gave rise to a remark by W.M.E. L'Estrange that this was too shallow 'and the heat of the sun soon melted the bitumen out of the pipes and insulation troubles were experienced after every rain.' (55)

FIG. 15. A 100 kW,110 V.,d.c. power station built by the German Edison Co. in Berlin in 1884. This is shown for comparison with the contemporary Brisbane power station (Fig.14). The economy in space with a different arrangement of countershafting is evident.

FIG. 16. View along William St, Brisbane from the Parliamentary buildings, 1893. The Government Printing Office power plant was housed in the building with the chimney, marked X. The underground mains connecting the power plant with the Parliamentary buildings ran along William St. The flood-damaged Victoria Bridge is seen on the left.

The following description of the construction of this type of mains was given in a paper read at a meeting of the Electrical Association of N.S.W. in 1891. (56) —

> The copper bars are each wrapped spirally with a special jute cord and two or more conductors are wrapped together with another spiral covering in an inverse direction. These are inserted into an iron tube, the ends closed with vulcanite plugs and an insulating compound composed of bitumen and ozokerite [a mineral wax] is forced into the tube completely impregnating the jute and filling the vacant spaces (Fig. 17)

Finally, more than three years after the contract with the Edison Co. had been signed, the plant operated for a few weeks with no particular problems other than excessive voltage drop in the underground mains; this will be discussed shortly. However, in August 1886 a fire broke out in the Legislative Assembly Chamber. It was attributed to Tomlinson's replacing fuses with solid connections in part of the wiring but details of the event are complicated and a lack of co-operation between the Government Printing Office Engineer (Joseph Dorsett) and Tomlinson is very evident. The full explanation is given in a 19 page report tabled in the Legislative Assembly in October 1886. (13) Tomlinson was obliged to resign in spite of his strong objection to the criticism by the various experts called in to give evidence.

There will be further reference to the project and its difficulties. Meanwhile it is of interest to note the very large capital investment spread over three years to provide about 30kW of power with a similar capacity as intended reserve, although both dynamos had to be run to meet later additions to the lighting of the Parliamentary buildings. The major items were: New building, £13,043; steam plant, £2747; dynamos, and lighting installation, £2020; street mains, about £600 — a total of over £18,000. This would be equivalent to about $1 million in today's currency.

BARTON AS QUEENSLAND GOVERNMENT ELECTRICIAN: It was not surprising to find that Barton was appointed to replace Tomlinson thus becoming the third occupant of the position since June 1886. The appointment was gazetted on 3 November 1886 at a salary of £250 per annum. The Queensland Government Gazette described the position as 'Government Electric Engineer.' (57) Fortunately there is a little information about this period of Barton's tenure of the position thanks to W.M.E. L'Estrange, a relative and a close associate for many years, who recorded the following in his Chairman's address to the Institution of Engineers, Australia, Brisbane Division in 1934. (55) This extract from the address is prefaced by L'Estrange's comment on the wiring of the

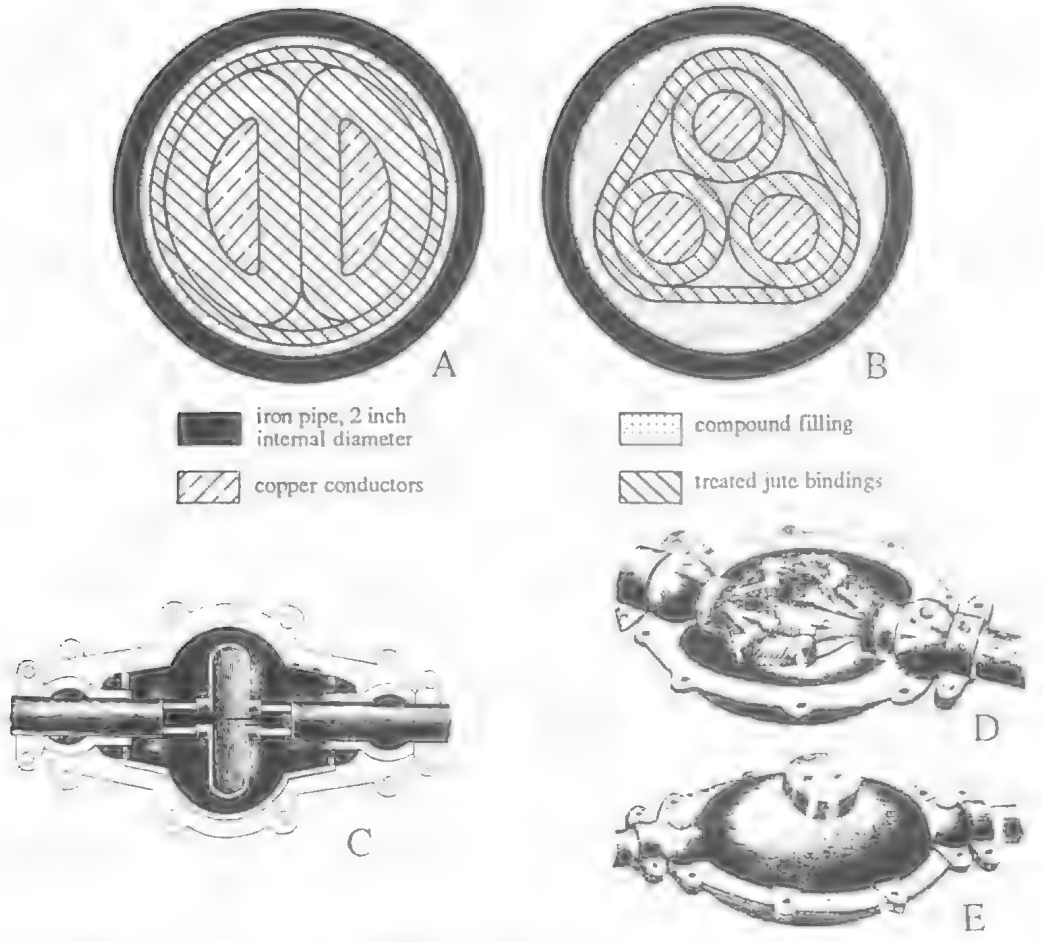


FIG. 17. Details of the 110 V.,d.c. underground mains (known as 'Edison Street Tubes') connecting the Government Printing Office power plant to the Parliamentary buildings. The first installation in 1884 was a two core type and the second, in 1892, a three core type. The mains were made up in mostly 20 ft lengths thus requiring a junction box for each length along the route of over 1200 ft. To provide for expansion, the connections in each junction box were flexible and to prevent ingress of moisture each was filled with a bituminous compound. **A**, probable cross-section of Edison two core mains, installed in 1884. Conductor size, 0.2 sq.in. **B**, probable cross-section of Edison three core mains, installed in 1892. Conductor size, 0.1 sq.in. **C**, two core junction box, cover removed. **D**, three core junction box, cover removed. **E**, three core junction box, cover in place.

Parliamentary buildings and presumably of the Printing Office —

> The wiring of Parliament House had been carried out with 'Underwriters Wire' from America, where it was often called 'Undertakers Wire' owing to its poor insulation. It consisted of unstranded wires up to eight gauge, which had been covered with asbestos thread impregnated with ordinary white-lead paint. In those days paint figured largely in electrical work, all armature windings being 'insulated' with red-lead paint.
>
> As Parliament only sat in Winter time when the Queensland air is very dry, these wires never gave any trouble, except at the joints, where their thickness lead to breaking of the soldering. To quote Mr Barton's own words — 'The fittings were, however, very bad. All the lights had to be fixed on gas fittings, the wires being tied at intervals, while the lamp holders were clamped on below the gas jets. Yet earths were rare, except on the great gas rings above the 'House'. Eventually the electric lamps were fixed on a large circular board which fitted inside the gas ring. After a few trial runs, the members complained of glare and demanded softening of the light, which was accomplished by Fleming, the Gas Fitter and Plumber, hanging a circular sheet of ground glass under the light.

All went well for a week or two. My instructions were to have the electric lights on before sundown, usually half an hour but a sudden thunderstorm led to the gas being lit, and disaster followed. Fortunately the Chamber was empty, but five minutes later the members would have been hurrying in, and Mr Bernays (58) (of the Gas Company) would have been injured, for the heat caused by the gas flames above the sheet of glass caused it to burst. As it was four feet in diameter and made of thick plate glass, and weighed some hundred pounds, the effect was great. One triangular piece cut a deep hole in Mr Bernays table.'

Before these events, and prior to Mr Barton's advent in Brisbane, the machines, of the Edison type, had been erected at the Printing Office, where supply was first made. The Government Printer of these days was George Beal, the perfect man of business from 10 am to 3 pm. (After that his address was the Sovereign Hotel, where he foregathered with his bosom friend Owen Gardiner, the Gingerbeer King. Like most Queenslanders of that day, they both believed in whisky as the only specific against disease.) The Engineer was Joe Dorsett.

I again quote Mr Barton. 'Dorsett was an excellent erecting engineer, and his engine rooms were patterns of neatness and solid cement foundations but he could never get away from the 'semi-portable' type of machine. To economise space and allow of oiling the engine must sit under the boiler and must not run at more than 120 revolutions per minute. The shafting and belts needed for dynamo driving were of course imposing.

These Edison dynamos were of the intermediate type. (59) They came from Edison's works where Hopkinson's work had caused a shortening of the magnetic circuit, but they still retained the triple magnets with six energising coils, connected up to a little switchboard by twelve wires that easily lent themselves to wrong polarity connection. This peculiarity led to an amusing incident as soon as the plant had been handed over to the Government and placed under the control of my successor [T. Tomlinson] a gentleman connected with the Military Forces and holding a great reputation in submarine mine control. Jimmy Knight, my cleaner, had disconnected these wires for cleaning purposes, as he had done under me every week, but Jimmy had never connected them up again, being quite innocent of any electrical lore. When the military gentleman appeared and ordered Jimmy to connect up the wires, Jimmy was aghast, but an old sailor is not easily cornered. He faced the enemy saying "I done it at Mr Barton's orders as usual, but I won't do them up again till he tells me." Many hours passed before a light could be got to glimmer. Eventually the telephone brought me to the spot. As the Contractor's engineer, I had to help, but the great man's fame had suffered. He only lasted a few weeks more, and then I was appointed to take permanent charge with the high sounding title of 'Government Electrician'. My duties were those of an ordinary shift engineer, but I had no jurisdiction in the engine room. My place was in the dynamo room and patrolling Parliament House to see that no lamps failed to light for it was the rule that all lights must be alight from sunset till the House rose; the plant then shut down. Thus we always ran at full load and did so for the simple reason that governing was impossible with that Robey semi-portable engine if the load varied appreciably.

Dorsett's fame ran so high as a careful engineer, and as the man who successfully supplied power for those Edison dynamos, that the new Courier building was fitted with Robey undertype engines on his advice and also the new building of the Telegraph Newspaper Company. Until the linotype machine invaded these three offices, the Robey engines reigned supreme. Then their poor governing seems first to have been observed and also the irregularities due to flapping belts driving long lines of shafting.'

In the winter of 1887 alterations and extensions were made to the electric lighting of the Parliamentary buildings both to increase the level of illumination and improve the safety of the whole installation. The two central chandeliers in the Legislative Assembly Chamber were replaced by a cluster of 24 shaded Edison lamps. There was still a lack of confidence in electric lighting as it was reported that the gas lights were being rearranged 'so that they can be used in the event of the electricity failing through one of the many causes that are likely to affect it.' (60)

At least during 1887, if not earlier, Barton had been considering going into partnership with a Brisbane electrician, C.F. White and there is evidence that an agreement was reached between them in the summer of 1887/88. Whatever the circumstances, Barton submitted a conditional resignation from the position of Government Electrician on 19 January 1888. His proposal to the Government was that he would undertake the supervision (but not the manual labour) of all electrical work in connection with the following: Parliamentary buildings and the Government Printing Office; the bells and telephones at the Government Printing Office and the Colonial Secretary's Office and the Railway plant at Brisbane station (later Roma St). For these services he requested an annual salary of £150. His resignation was accepted from 16 February and the above conditions agreed to. While the position of

Government Electrician no longer appeared in the annual list of Government staff it is evident both in his own correspondence and in Government documents of the period that his title was retained until the above arrangement was concluded on 27 February 1894. (61) During the interim period Barton had a dual role as a Government adviser and supervisor on the one hand and on the other hand as a contractor offering to carry out the recommended work. This seems to have caused a few minor difficulties but the fact that the arrangement lasted for six years suggests that it was generally acceptable. On Barton's side, the monthly income must have been most important as financial difficulties of the partnership increased.

No immediate action appears to have been taken to replace Barton except that J. Dorsett, the Government Printing Office engineer, had his responsibilities extended to the lighting of the Parliamentary buildings from January 1894. The position of Government Electrical Engineer was advertised early in 1896 and filled by John Hesketh.

A problem with the electric lighting of the Parliamentary buildings pointed out by Mr Pentland (Principal Electrical Engineer, AELP& SCo.) in 1886 in his report following the fire was the excessive voltage drop in the underground mains connecting the Government Printing Office power plant with these buildings. He was cautious in saying that it would be necessary to balance the savings effected in fuel costs by providing new mains against the interest charges on the cost of such provision. There appears to have been no action until October 1888 when the Government Printer proposed a duplication of the mains. This proposal was repeated in September 1889 and again a year later at which time the Works Department gave an estimated cost of £500. Barton's part in this is not clear as his proposals seem to have been impractical including one in which he gave estimates for a power plant adjacent to the Parliamentary buildings. He certainly considered a three-wire system with the third conductor overhead, pointing out that since both dynamos would need to be run at the same time to meet the expected additional load from the lighting extensions, this was no longer an objection. It also seems possible that Barton was considering offering to give supply to the Parliamentary buildings from the Barton, White and Co. power plant in Edison Lane but as the date of his notes relevant to this cannot be determined, this is surmise.

Finally, in July 1891 the Works Department requested the Queensland Agent-General in London to obtain quotes for 420 yards of 'Edison Tubes'. These were offered by the Brush Electrical Engineering Company, London at £1 per yard and delivered in November. Barton was in charge of the laying of the new mains and in February 1892 it was reported that the work was almost complete. (61) Just what was the intended mode of use has been made clear by the following extract from a newspaper article describing a trial of new lighting installed by Barton, White and Co. in the Parliamentary buildings (62) —

> The current is transmitted through the new Edison underground mains, which carry three conductors, one of which is devoted to the new wing, one to the Assembly, and one to the Council Chamber. The return passes through the two conductors of the old mains, which were previously used as a lead and return. The mains consist of pure copper embedded in bitumen, and are protected by iron piping supplied by the Edison Co. ready for fixing. . . . Last evening the dynamos ran 115 volts pressure while the pressure supplied to the House was about 94 volts, and the current consumed averaged 240 amperes.

The last sentence shows that the voltage drop problem of several years before still persisted, the advantage of the decreased resistance of the mains being offset by the increased current now required by the lighting system. The use of 96 volt lamps was apparently an acceptable solution but had the inherent difficulty that to ensure that approximately 96 volts was available at the lamp location the generated voltage would need to be adjusted to suit the number of lamps in use. There is a description of the new lighting system later.

The above account differs considerably from those given previously as recollections and, in particular, corrects the long established notion that Barton himself either developed and constructed (or constructed under licence) the new mains in about 1887 or 1888 and that there was at that time a three-wire 220/110 volt system substituted for the original two-wire 110 volt system.

The first applications of electric lighting in Brisbane were to improve the conditions for typesetters, railway workers and politicians, in that order. The era of the incandescent lamp had begun but while its advantages over gas were easily demonstrated, the relatively high cost was a major deterrent to its general adoption.

FOUNDATION AND EARLY DEVELOPMENT OF THE ELECTRICITY SUPPLY INDUSTRY IN QUEENSLAND

BRISBANE AREA, 1887 TO 1889

PARTNERSHIP — THE WHITE CONNECTION: In early 1888 Edward Barton resigned from the position of Government Electrician that he had accepted in 1886 and reached an agreement with the Government that he should have more limited responsibilities from February 1888 and a lower salary. (63,64) This arrangement proved very helpful over the following years. In the summer of 1887/88 he had already formed (in effect) a partnership with Cedric Francis (Frank) White, a brother of Thomas Edward White, Queensland manager of Messrs Alfred Shaw and Co., although this was not advertised until 17 March 1888. (65,66) Possibly the announcement was delayed until Barton's new agreement with the Government had been finalised.

FIG. 18. C.F. White, a Brisbane electrician, and E.C. Barton, the part-time Queensland Government Electrician advertised their partnership in the *Queenslander* of 1888. White's advertisement on 10 March changed to Barton, White and Co. on 17 March.

The exact date of the formation of the partnership is not known but it was certainly under consideration before September 1887 since a letter written at this time by George Barton, Edward's father, expressed what was to be continuing concern about the proposition and enquired 'How did you end about that matter?' (67) As a guide to his commitment, there is preserved a list of individual payments by Barton and C.F. White for the first several years of the partnership and this shows an amount of £120 16s 7d paid by the former in 1887. (68) It is clear that T.E. White played a most important part in financing the partnership; indeed, F.R. L'Estrange stated —

> there would not have been a Barton and White if Mr C.F. White was not financed by his brother ...(33)

Barton's connection with Messrs Alfred Shaw and Co. has already been referred to in connection with the completion of the electric lighting of the Parliamentary buildings. As L'Estrange continued —

> Mr Barton ... convinced Mr T.E. White that there was an excellent opening for the introduction and advancement of electricity supply. Mr Barton had no capital but succeeded in arranging for Mr T.E. White to finance his brother C.F. White in a partnership to be known as Barton and White as he [T.E. White] considered that C.F. White had selling ability and a knowledge of importing, stock-keeping and office procedure, and on the other hand Mr Barton had ability and experience to design, manufacture and install all kinds of electrical machines and apparatus; also that Mr White's firm [Alfred Shaw] could increase their imports and sales of machines and accessories which the new firm of Barton and White would require. Mr. T.E. White then arranged finance for his brother C.F. and opened an account for the new firm with Alfred Shaw and Co. It is to be strictly understood that Mr C.F. White would be responsible for the office, stores purchasing and sales, whilst Mr Barton would be responsible for the engineering side and staff.

Before the partnership was announced, C.F. White had established an electrician business in Creek St, Brisbane and his advertisments listed 'Electric Light, Electric Bells, Telephones, Speaking Tubes, Lightning Conductors &c, &c.' The last advertisment under White's name appeared on 10 March 1888. The advertisment

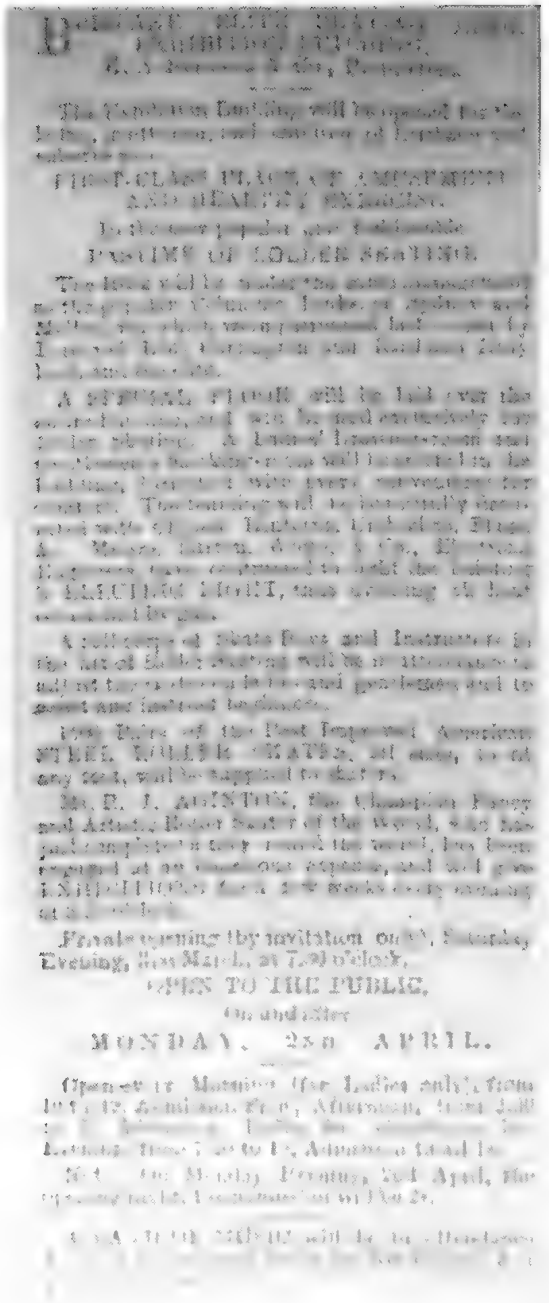


FIG. 19. Advertisement for the Roller Skating Rink of K.A. Skinner and Co. in the Exhibition Building, 24 March 1888. Barton, White and Co. contracted to supply electric lighting from a small power plant nearby. The Rink was opened to the public on 2 April but was destroyed by fire on 13 June.

on 17 March described the partners as 'Electrical Engineers', and 'The Exchange' was added to the Creek St address. (69) (Fig. 18) A further addition in July 1888 was: Works, 149 Elizabeth St.

The only specific record found to date of work attributed to C.F. White was in connection with the National Association Show in August 1887 (70) when —

> an interesting machine was shown by Mr C.F. White of Creek St. It was a dynamo capable of supplying 40 electric lights and it is used to light up during the evenings the grand saloon of nautical exhibits shown by the British India Co. ..

It seems quite likely that Barton would have been involved since the 'Goods Received' book of this period kept by White shows predominantly a range of components and material for the installation of electric bells.

LIGHTING A SKATING RINK: According to W.M.E. L'Estrange (55) the first work undertaken by the partners was the installation of a generating plant consisting of a Brush Co. 'Victoria' dynamo driven by a portable steam engine. The following details of the

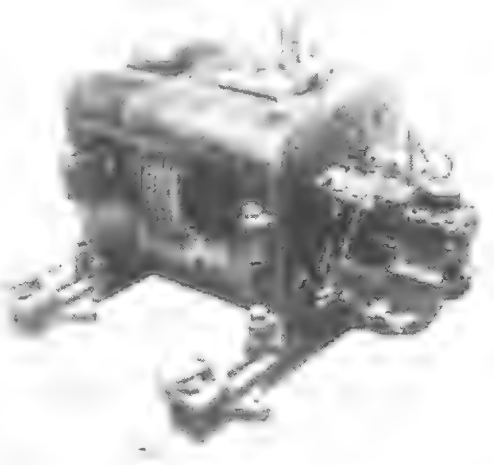


FIG. 20. Brush Co. Victoria dynamo from the Queensland Museum Collection. This is probably similar to that used by Barton, White and Co. at the Exhibition Building from April to June 1888 and at Telegraph Lane in August 1888 to provide the first commercial electricity supply in Queensland. At this time copper or brass strips were used to provide a sliding contact with the commutator but these were later replaced by carbon blocks as in this illustration.

circumstances leading up to this are based on a lecture by G.G. L'Estrange, son of W.M.E. L'Estrange (71) —

> A British India boat, thought to be the 'India', being one of the first to be equipped with electric light, called at Pinkenba in 1887. Apparently the electrical installation had been troublesome and the Captain solved his problems by off-loading the generator.

During March 1888, Messrs K.A. Skinner and Co. set up a roller skating rink in the Exhibition Building in Gregory Terrace, Brisbane and engaged Messrs Barton, White and Co. to provide arc and incandescent lighting. (72) This would have been the first public entertainment area in Brisbane to be lit by electric light and thus the installation provided an excellent opportunity to show the advantages compared with gas lighting. The rink opened on 31 March as announced with an enticing newspaper advertisment. (Fig. 19) G.G. L'Estrange continued thus —

> The arrangement was for Barton and White to own all plant and equipment and Messrs Skinner to pay for the service provided. For this purpose Mr Barton gained possession of the generator left by the B.I. boat, also an old traction boiler and a Marshall engine. These were set up as a generating station in a shed adjacent to the skating rink. In order to finance this project Barton and White borrowed to the limit of their credit. This enterprise was a great success and the money was rolling in until, early one morning on 13 June 1888, the Exhibition Building was burnt to the ground and everything was destroyed except the power house. [Arson was suspected.] This left Barton and White with debts and a power house for which they had no use.

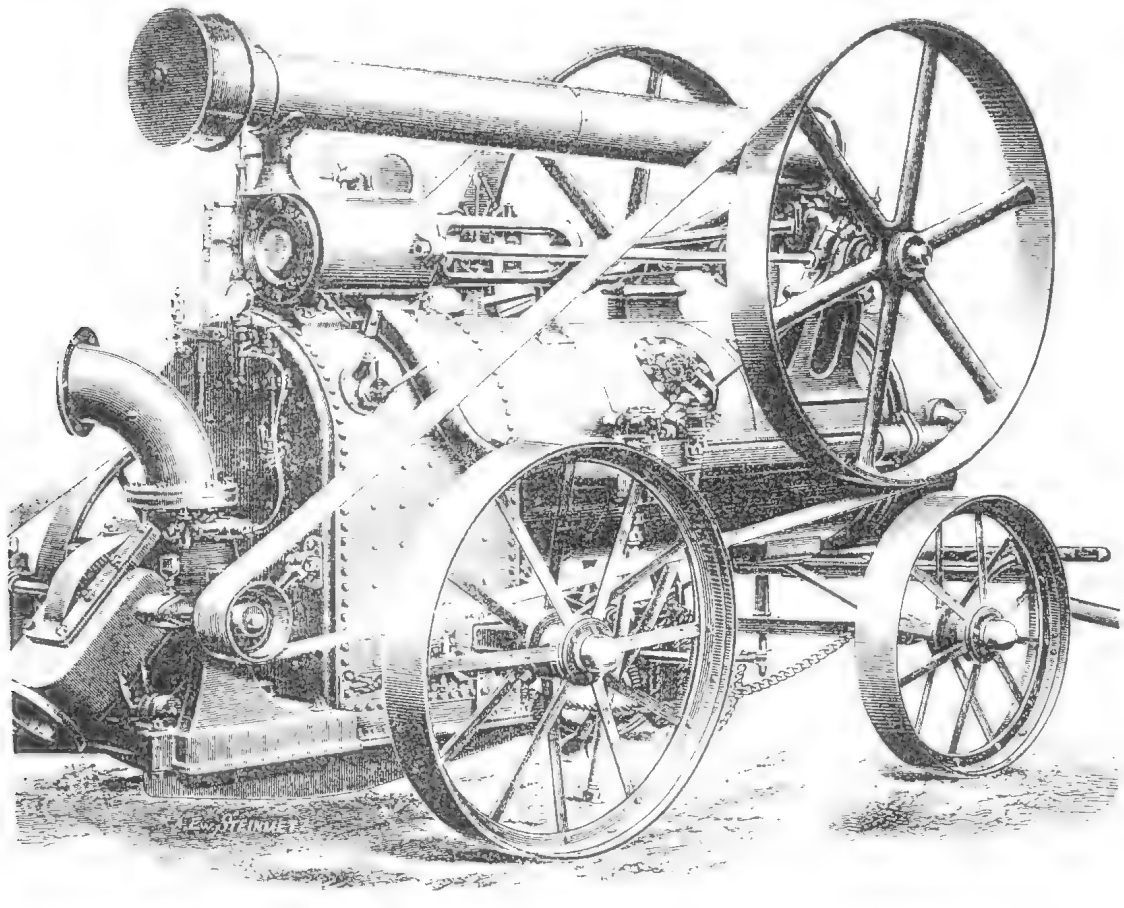


FIG. 21. Portable steam engine manufactured by Messrs Brown and May, England, c.1886. It is shown arranged for belt driving a water pump but is otherwise probably similar to the engine used by Barton, White and Co. to belt drive the 'Brush' dynamo. (Fig. 20)

FIG. 22. Artist's impression of Barton, White and Co.'s first workshop in Telegraph (later Edison) Lane in 1888. This and the generating plant were housed in a shed, 40 ft by 15 ft. Barton himself probably provided this imaginative illustration to show the intended scope of the firm's activities.

The two arc lights and about 116 incandescent lamps valued at £70 were destroyed but had been insured. The power house was fortunately about 100 yards away. (73)

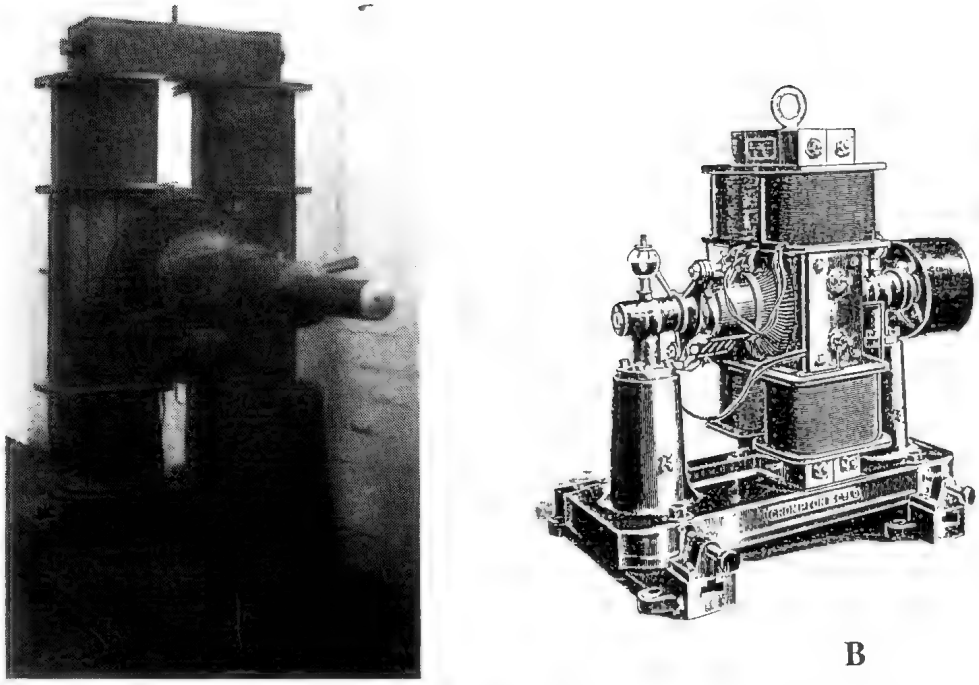
THE FIRST COMMERCIAL ELECTRICITY SUPPLY: The young partners wasted no time in recriminations however as ten days later the following announcement appeared in the *Brisbane Courier* (74) —

> Messrs Barton, White and Co., electricians, are just completing negotiations with the Post Office Authorities for the lighting of the mail-room with incandescent lamps for three months by way of an experiment. During the summer nights the employees of the Post Office have suffered considerably through the vitiated state of the atmosphere in this room caused by the large consumption of gas and bad ventilation. Arrangements are also to be made for the erection of a powerful arc lamp in front of the Post Office. There is no doubt that the experiment will prove successful as the electric light has been used with advantage in the Post Offices of both Sydney and Melbourne for a considerable time past.

According to G.G. L'Estrange, while the negotiations were proceeding, and as a means of utilising their asset, the plant was set up in a location near the Cricket Ground, South Brisbane where it was apparently used to supply lighting for Cricket Ground activities, and also arc lights in nearby Stanley St. He believed that these were erected by Trackson Bros. (71)

The Post Office lighting became a reality two months after the fire following a trial reported in the *Brisbane Courier* of 3 August 1888. The occasion of giving the first commercial electricity supply in Queensland was described in the following extract from the *Queenslander* (75) —

> The General Post Office building in Queen St was lighted up on Monday evening [20 August] for the



A B

FIG. 23. **A**, the second dynamo installed at Telegraph (later Edison) Lane, probably late in 1888 is believed to have been manufactured by Crompton and Co. Ltd and rated at 110V.,225 A. The illustration is almost certainly of a replica built by Barton's firm in about 1899 for their Ann St. power station. The field system is bipolar, the windings being arranged in two halves set on either side of the pole faces. The armature would have been ring wound. **B**, a text book illustration of a similar, though probably smaller, dynamo manufactured by Crompton and Co. Ltd c.1890. This shows the type of brush gear missing from the dynamo in Fig. 23A.

> first time by electricity, the contractors, Messrs Barton, White and Co., whose offices are situated in Elizabeth Street at the rear of the Government premises [actually in Telegraph Lane], having completed their arrangements for starting work. The lighting was confined to the ground floor, where the despatching and receiving rooms, the letter carriers' department, the delivery windows, and the private boxes are situated. In this large hall thirty-two of the fifty volt Swan lamps have been placed, each being of about 16-candle power, and the light given was fairly satisfactory as a whole, though in some places the great height at which the lamps were hung was somewhat of a drawback. The machinery is situated in a large shed on the contractors' premises. The shed measures 40 ft by 15 ft. A 100-light Victoria Brush dynamo (Fig. 20) and a 12-horse power Brown and May engine (Fig. 21) were in use, and the firm intend at no distant date to offer the electric light as well as motive power to other buildings in the vicinity.

The above description of the steam plant differs from that given by G.G. L'Estrange who, when relating many years subsequently the events at the Exhibition site, was probably relying on hearsay. The three months' trial just referred to must have been regarded as a success since the G.P.O. was still shown as a customer many years later.

OPERATIONS AT TELEGRAPH (EDISON) LANE AND SOME EARLY CUSTOMERS: Another contemporary record is an illustration of Barton, White and Co.'s workshops (Fig. 22) published in 1888 in the form of an advertisement depicting many workshop operations and items of electrical equipment. (76) The artist is not named but could have been Barton himself. Aldine stated that —

> with the help of high-class machinery, they do all classes of electrical work. They manufacture all the fittings for electric light and power; supply brackets for lamps, sockets, cut-outs, portable hand lamps, reflectors, arc lamps of 2000 candle power, electric motors, etc and undertake electrical work in all parts of the Colony. (76)

This describes a most ambitious undertaking at such an early stage and when electricity was so much more expensive than gas. In this connection it is interesting to find an

advertisement by the firm in July 1888 describing battery-less gas lighters which they had imported from the Matchless Electric Gas Lighter Co. for about ten shillings each. Pressure on a lever rotated a tiny electrostatic generator which provided a sufficient spark to ignite the gas. (77)

On 22 September 1888 the *Brisbane Courier* stated that a small electric motor known as the C and C had been introduced to Brisbane by Messrs Barton, White and Co. —

> The motor is applied to driving a ventilating fan which revolves at the rate of about 3000 revolutions per minute. The fans [blades], six in number, are of brass, and form a wheel 12 in. in diameter. This, when in motion, is sufficient to ventilate a room 15 ft by 25 ft, and certainly gives a remarkably strong current of air, the effects of which can be felt all over the apartment. The amount of electric current employed is equal to one and a half times that required by an ordinary 16 c.p. lamp ... The little machine is an illustration, on a small scale, of the possibility of distributing power for driving small machines at a distance from the central dynamo. In the United States an electric light apparatus in many cases earns money in the daytime by driving machinery for small industries, and at night by supplying light.

In the summer of 1888/89, the Company was successful in obtaining contracts for fitting 63 automatic electric fire alarms in the Government Printing Office and 150 in the Parliamentary buildings. The alarms were made by the firm and were based on the movement of a bi-metal strip when heated. At a predetermined temperature the strip completed an electric circuit and an alarm bell rang. It was reported that further orders had been received from mill owners. (78)

Aldine described the generating plant in Telegraph Lane in 1888 as —

> a steam engine at the rear of their premises [which] drives two dynamo-electric machines, which supply the current for the electric light in the adjacent General Post Office and other premises in the neighbourhood.

So the initial equipment was apparently added to very soon and the second dynamo was probably that included in an undated list of plant installed at the 'Edison Lane Works', as the site in Telegraph Lane was later named. The entry reads: 'Two-pole Crompton Dynamo — output 240 amps at 110 volts.' (79) (Fig. 23)

The first move from the shed was to a four-storey masonry building (Fig. 24) in Telegraph Lane at the rear of the site referred to as 149 Elizabeth St. The exact position of the shed relative to the building is not known but it was presumably very close. The picture is confused by the ambiguous phrasing of an article in the *Australasian Ironmonger* of July 1889 which stated that Barton, White and Co. were 'having to remove their engine shed to make room for their new building.' The building was only new in the sense of being newly acquired; possibly there were access problems with the shed in its initial position. Each floor was about 400 sq. ft and rent, which presumably included a small area adjacent to the building, was £4 6s 6d per week, payable to Mr David Marks. It would be surprising if Barton regarded the arrangement as ideal for his purpose. He certainly considered the rent to be excessive. However there were probably few buildings in the locality adaptable for his purpose and, in particular, having an internal chimney of reasonable height.

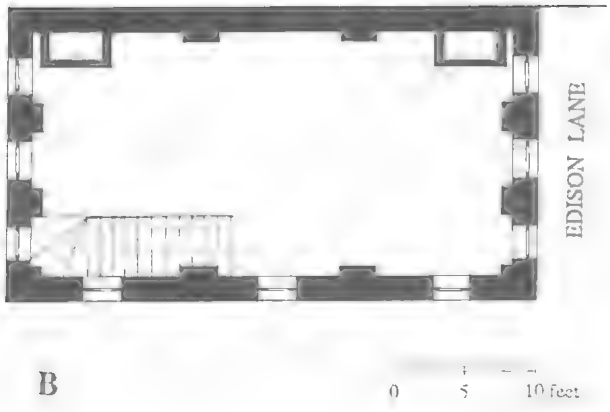
Both F.R. L'Estrange (18) and G. Mackenzie (80) gave accounts of the allocation of space and the installed equipment. Combining these it seems that the basement and four floors of the building were occupied thus:

Basement: 2 steam engines and belt driven dynamos (Figs 25,26)
Ground Floor: 2 boilers, wood or coal fired, 1000 lbs of water per hour evaporative capacity, pressure probably 110 lbs per sq. in. (Fig. 27)
First Floor: Offices and Stores
Second Floor: Workshop
Third Floor: Fitters' Shop (Fig. 28)

No layout plan of the installation in the basement has been found but evidently the base load plant comprised a Marshall steam engine with belt drive to the Crompton dynamo previously referred to. A photograph of the basement taken in the 1950's shows foundations which were described by F.R. L'Estrange as those of a steam engine and dynamo; there is no indication in the photograph of where the second steam engine-dynamo set was located. Mackenzie mentions a dynamo of about 7 kW driven by an old locomotive engine and boiler in an adjacent shed.

There is no progressive record of additions to the power plant for the first several years so it is not possible to relate the above information to a particular period. However in a letter to a power station engineer in NSW dated 6 August 1896 (81) Barton included a description (given later) of the major equipment in connection with his application for an Order in Council under the 1896 Electric Light and Power Act.

A



B

FIG. 24. A, Barton, White and Co. power station and works in Edison Lane. The building was in use from 1889 to c.1900. The basement and floors were occupied thus: Basement, steam engines and belt driven dynamos; ground floor, boilers; first floor, offices and stores; second floor, workshop; third floor, fitters' shop. The overhead distribution system is seen above roof level. B, horizontal section of building. C, artist's impression of Barton, White & Co's power station in Edison Lane.

Conditions for the engine driver in the basement must have been extremely unpleasant and no doubt drainage was a problem. It is likely that Barton asked the Brisbane Council to provide a pipe drain from the near vicinity and below the floor level of the basement. Certainly a contract for laying down such a drain was let by the Council in September 1889 and it is of interest that on the contract drawing, signed 19 September 1889, the name 'Telegraph Lane' has been crossed out and 'Edison Lane' substituted. This followed a request by Barton to the

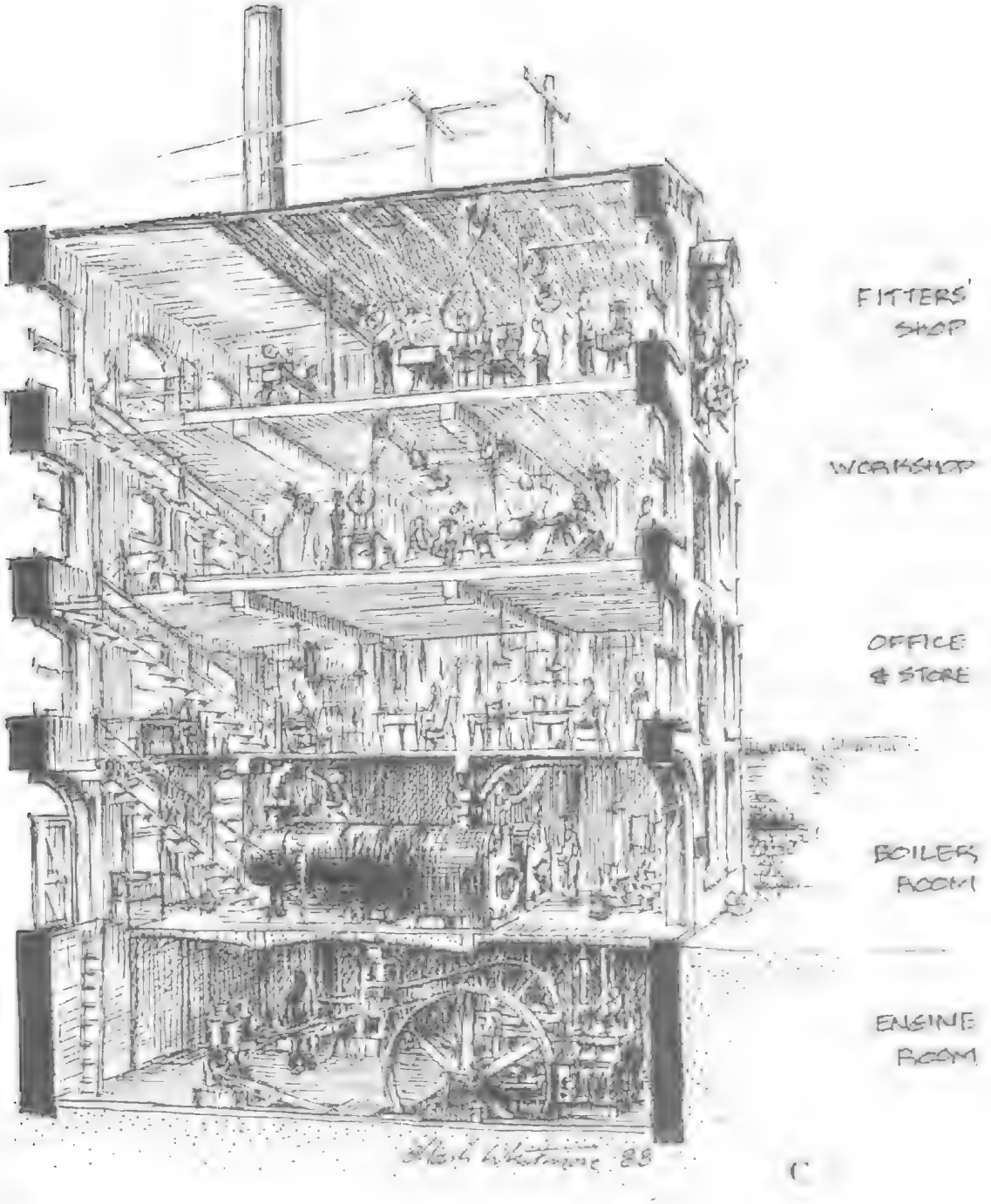


FIG. 24. (continued)

Council a few weeks earlier to have the name changed. (82)

At ground level the two boilers were arranged side by side along the length of the building. Water tanks and a primitive condensing system were located in the immediate vicinity of the building probably between it and the Elizabeth St frontage to the

FIG. 25. The basement engine room at Edison Lane. The foundations for a steam-engine belt driving a dynamo were photographed fifty years after the site was abandoned.

site. Mackenzie recalled the arrangements for switching and voltage control of the generating plant —

> The switchboard was mounted on the wall in the [basement] engine room and ... to reach the switchboard when the plant was operating, the attendant had to pass underneath the driving belt of one of the engines. A platform of wood covered the belt at the bottom, the Engine Room being very small for belt driven sets. Just outside the door of the boiler house an electric [voltage] controller operated the governors of the engines. If the voltage was allowed to become too low the moving arm of the contact would stick causing the engines to race when the pressure of steam increased. One night the man on shift was concerned at the excessive speed. Mr Barton was in his office at the time and raced downstairs and saved the situation.

Mackenzie remembered the workshop arrangements on the two floors —

> The second floor was Mr Young's department where armature winding, manufacture and repair of speaking tubes, telephones and bells, underground and overhead mains were dealt with. The third floor was the fitter's shop in which Mr Angus Gillies was Foreman. The outfit consisted of two lathes, one drilling machine, one forge — also one machine for mounting discs (stampings) on armature shafts and balancing same. The motor driving the machinery was 2 h.p., 110 V, series type and the speed was regulated by coils of iron wire attached to insulators and mounted on an iron frame on the wall above the motor. The motor was very efficient, the brushes in use being copper gauze type, all fans, motors and generators being fitted with these in the Edison Lane period. Instead of telephones, speaking tubes were used

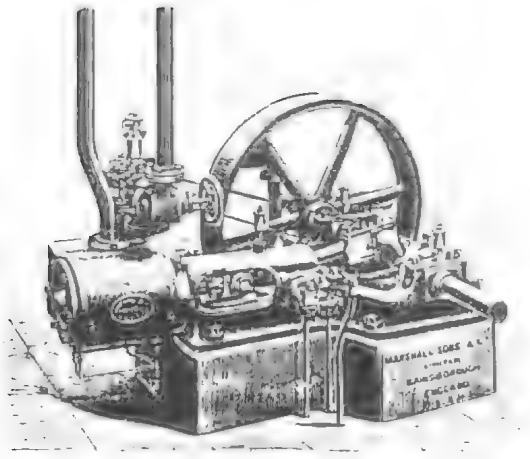


FIG. 26. A Marshall Sons and Co. Ltd, England, horizontal steam engine. A single cylinder and a twin cylinder engine of this make and type powered the Edison Lane basement power plant.

for communication between the different departments.

Initially a two wire 110 V system of distribution mains would have been used. The three wire system (Fig. 29) was certainly adopted by 1895 and possibly earlier. It had been developed by John Hopkinson, an english electrical engineer, and was known as the Edison system because it was widely adopted in the USA. The voltage was 220 between one pair of conductors and 110 between each of these and a third conductor which would have been connected to earth at the generating station. The lower voltage was used for lighting and small motors and the higher voltage for larger motors with resulting economy in distribution costs.

Obviously one of the early objectives of the new company was to restore the interest in electricity shown by the public in 1882. The Brisbane Municipal Council had been considering the possibility of electric lighting for some years but the first proposal by Barton, White and Co. to light Queen St was made to the Council in April 1888 or shortly before. This was about the time that the Company contracted to provide electric lighting for Skinner's skating rink at the Exhibition building. Their offer was to light Queen St between Creek and Edward Streets for a month free of charge, as an exhibition of the capabilities of the light. On 11 June, the Finance Committee of the Council recommended that it be left in the hands of the Mayor to accept or reject the proposal. (83) It is clear that the majority of the Council were averse to increasing the expenditure on street lighting and as the *Brisbane Courier* of 23 June 1888 reported —

> it would be unreasonable to expect Messrs Barton and White to go to the expense of erecting poles and lamp fittings if there was no likelihood of the Council eventually adopting the electric light system. The present cost of lighting by gas is about three shillings and six pence per week per lamp including cost of material and erection. Each electric lamp would be equal to about seventy-five ordinary gas jets in a cluster.

So the first attempt by Barton, White and Co to provide greatly improved street lighting in

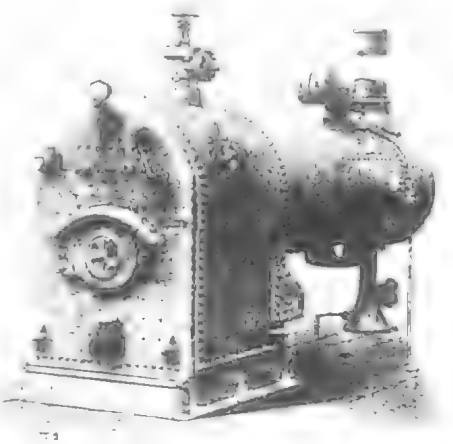


FIG. 27. A Marshall Sons and Co. Ltd locomotive type boiler. Two of these were installed in the ground floor of Barton, White and Co.'s power station in Edison Lane to supply steam to the engines in the basement. This type of boiler would have been chosen for its narrow width and simple flue. The boilers are assumed to have been installed side by side and fired from the area inside the doorway to Edison Lane. The principal fuel was wood as the use of coal, while cheaper, led to complaints about smoke nuisance.

FIG. 28. Barton, White and Co.'s third floor workshop in Edison Lane. This view shows the shafting, pulleys and belts used to drive the workshop machinery from an electric motor. Drive to a particular device was controlled by overhead fast and loose pulleys selected by moving the belting with long wooden levers.

Brisbane ended in rejection in the face of opposition by the gas lighting industry which had been firmly established for over 20 years.

By 1889 Barton, White and Co. were gaining recognition for their activities as is shown by the following (84) —

> Lighting by electricity is extending rapidly in Brisbane. The latest application of the system is at the Royal Hotel, Queen St. The bars, passages and ground floor rooms are now lighted by electricity to the exclusion of gas and while the illuminating power has greatly increased, the temperature has been lowered to an appreciable extent.

F.R. L'Estrange recalled a visitor attempting to turn on the light by applying a lighted match to the lamp base. A notice warning against this was found in New Zealand (Fig. 30).

At this time the electric motor was still a novelty and it was not taken for granted that the same mains could supply both light and power. So we find in the *Queenslander* of 20 July 1889 —

> During the last fortnight an interesting and successful application has been made of the electric motor for practical work by Messrs Barton, White and Co. The erection [sic] of their new premises necessitated the removal of their electric light plant from their yard and with it the steam engine which drove their shop machinery. The dynamo, which is now situated in a neighbouring yard and is kept running all day to supply electric light, furnishes current also by wires to an electric motor in Messrs Barton, White and Co. workshops. The generating dynamo is a Victoria [Gramme] ring machine running at 700 revolutions while the motor is by Elwell Parker and runs at about 1000 revolutions. The matter has aroused considerable interest and a number of gentlemen, desirous of seeing an electric motor in actual service, has visited the Works.

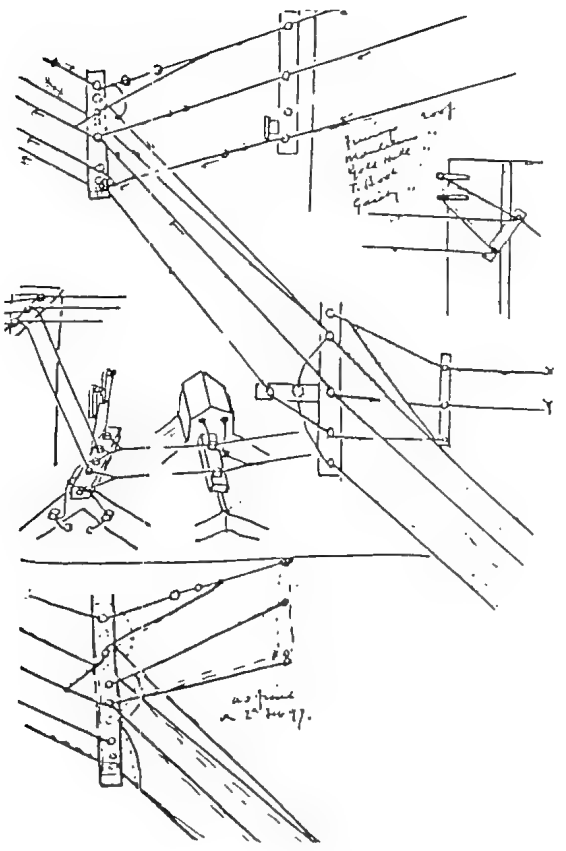


FIG. 29. Early forms of overhead line construction sketched by Barton c.1895 or earlier. The distribution system was initially 2 wire, 110 V.,d.c. but later was changed to 3 wire, 220 V. for economic reasons. The mains were supported on the rooftops of buildings in the small area of supply adjacent to the power station. After the passing of the Electric Light and Power Act in 1896, all distribution mains were required to be underground.

In the same year the firm's name was coupled with a second installation of an electric plant — at the premises of the Brisbane Newspaper Co. Ltd. The plant was fitted with what was described as the only automatic electric steam controller at work in Australia.

> It is the invention and work of Barton, White and Co. and is a piece of mechanism which by a system of ratchets and pawls opens and shuts the expansion gear ... according to the variations in load or pressure of steam, ... (85)

In August 1889 the opening of Central Railway Station, Brisbane was reported with special reference to the lighting arrangements. (42) Roma St Station and vicinity were lit in 1884 and the following account (42) described how the system was extended —

> The plant is now used to run five arc lights in the new railway station, and for this purpose cables for the conveyance of the current had to be continued through the new tunnel and under the two bridges. The work has been successfully carried out by Messrs Barton, White and Co. (Fig. 31) In the tunnel and under the bridges the cables are carried on substantial brackets provided with shackle insulators, with iron guards to prevent accidents from breakage. For the remainder of the distance the cables are carried on hardwood poles 8 in. square and 25 ft long. The cables are made of seven strands of No. 16 gauge copper wire, insulated first with a covering of cotton, then prepared rubber, and finally covered with a stout braiding of tarred yarn. The length added to the electrical circuit is nearly a mile and the electrical resistance is equal to one and a half ohms, or about half that of an arc lamp. The lamps are all of the usual 'Brush' type and uniform with the original lamps in use at Roma Street station. The total number of lamps in connection with both stations is fourteen, so that the dynamo has to run at an electrical pressure of 700 volts, instead of 500 volts as heretofore. In order to obtain this increased pressure, the pulleys on the countershaft have been altered so as to increase the speed of the dynamo.

Barton had the dual role of adviser to the Government and contractor. When repairs to

FIG. 30. Notice to hotel guests about turning on the electric lights.

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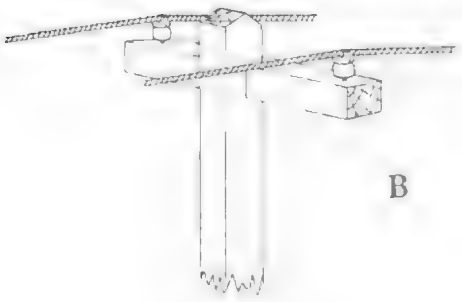


B

FIG. 31. A, Roma St Railway Station, Brisbane, c.1890. Electricity generated in an 'Electric Light Machinery Shed' located between the Station and the Normanby Tunnel supplied arc lighting in the area in 1884. In 1889 the lighting was extended to Central Railway Station, the overhead mains being erected by Barton, White and Co. One of the supporting structures is shown on the left of the illustration. **B**, details of the pole-top construction. The mains were insulated for 700 V.d.c. and were probably the first of this type in Queensland.

the dynamo armatures were needed in 1896, he carried out these as Manager of the Brisbane Electric Supply Co. Ltd, the successor to Barton and White. (86) By 1900 the Railways Department arranged to take electricity supply from the newly-built Brisbane Tramways Co. Ltd power station in Countess St. (87)

BRISBANE AREA, 1890 TO 1895

THE BRISBANE GAS CO. AND ELECTRICITY SUPPLY: Although the Brisbane Municipal Council had taken up neither the offer by Barton, White and Co. nor any other offer to undertake street lighting of the city by electricity in 1888, they called tenders in 1890 for lighting parts of the city. However action was deferred because they were advised that parliamentary authority was first required. (88) At the same time the Bribane Gas Co. Ltd was seeking to have the Brisbane Gas Co. Act under which they operated amended so as to enable them to provide electricity supply as well. A Select Committee of the Legislative Assembly was set up and evidence taken. (89) However the Council objected to the amendment of the Act because they wished eventually to obtain municipal control of electricity supply, and Barton, on behalf of his firm, also gave a series of reasons why it should be refused. Extracts from Barton's evidence given in October 1890 are set out below —

> I am a member of the firm of Barton, White and Company. We have been engaged in the supply of electric light for the last two years. Beginning with a small plant of 100 lights, we have gradually increased it to 600 lights, and are in a position to

supply street lights according to our tender to the Municipal Council as soon as we can get the poles erected. I believe it to be detrimental to the interests of the electrical industry that rights such as are included in this Bill should be given to any company, especially a gas company. Although nominally it creates no monopoly of light and power, experience proves that it will do so, as no city will tolerate competing lines of pipes, gas, electric, and hydraulic, or competing lines of poles. If the Gas Company acquires these rights, the Municipal Council, although hostile to this Bill, would be still more hostile to a Bill for granting similar powers to another company, and a firm like ours could not hope to obtain such powers against the powerful Gas Company and their unwilling allies, the Municipal Council.

This Bill, if enacted, would prove a great hardship to our firm, destroying our business, just as it is becoming remunerative. We have put our time and money into this business and demonstrated its advantages through two years of unremunerative hard work, and that the fruits of our labour should be handed over to the Gas Company would be a great injustice to us. It would also hinder the progress of electric lighting. ... It has been truly said that the Gas Company, with its wealth and organisation, could supply the city with electricity as well as any other parties; but I contend that it will not be in their interests to do so, and, as business men, they will not do so. If a time limit is inserted in the Act it will still not be in their interests to put down a plant until the five or ten years are nearly run out, provided that others can be deterred from doing so by occasional calling for tenders and similar inexpensive methods of showing activity. Thus the city will have to wait for five or ten years for the benefits of electric lighting. When the plant is put down it will not be to the Company's interest to push the new light, and high price or inefficient service would prevent the general adoption of the light. This would cause the Company no anxiety, as the gas consumption would be correspondingly undiminished. An Electric Light Company, on the contrary, would not delay a moment in obtaining the largest plant they could afford, and would push their wares, introducing motors, and all the latest improvements. The competition would be healthy, not cut-throat.

In continuing his evidence Barton admitted that a lot of his case was conjecture but asserted that the natural instinct of the Gas Company would be to soft-pedal the electrical part of their undertaking. He claimed that his company had resources sufficient to supply electricity within the city. They could within, say, four years extend the area of supply to a 10 mile radius. There was reference to the undergrounding of mains as required in New York and London. Barton commented that in Brisbane the city and suburbs could be supplied at a voltage of 100 or 200 but that it might be necessary to go a little higher. He stated that this voltage was not dangerous to human life but the firm was willing to lay its wires underground if required to do so.

The Select Committee summed up the position with a strong recommendation in favour of the Gas Company but the Bill was rejected by the Legislative Assembly on its second reading. (89)

In August 1890, Barton, White and Co. suggested that the Municipality of South Brisbane be lit by electric light and offered to submit an estimate of the cost. (90) The South Brisbane Council adopted a report on the offer which had been prepared by their General Purposes Committee and which had recommended that tenders be called for two alternative schemes, namely:
1. To supply the Council with plant to run 300, 400, 500 or 600 lamps of 16 candle power and to guarantee the working thereof 'for a period of years.' or 2. To light the Municipality with electricity for a period of 5 to 7 years, the tenderer to supply plant etc and lamps as above, giving the annual cost per lamp.

Neither scheme was adopted at that stage but in early 1893 a tender by Trackson Bros was accepted. The contract lapsed a few months later and the idea of lighting South Brisbane was temporarily abandoned.

PUBLICITY FOR ELECTRICITY: Contemporary press reports refer to Barton, White and Co.'s success with the introduction of electric fans and electric motors in manufacturing establishments. A one h.p. motor located a third of a mile from the generating station was hailed as an achievement — 'one of the first applications of electricity for motive power used industrially in Australia.' (91) Earlier in the year, the Electric Motive Power Agency Association Ltd had requested Messrs Barton, White and Co. to prepare a report on the 'dangers of electricity'. This was mostly relevant to the proposed 500 V. d.c. tramways system then under consideration; the conclusion was that a 600 V. circuit would be safe if it were put up efficiently and provided with guard wires, feeders, cut-outs etc. (92)

George Barton, Edward's father, continued to show great interest in his son's affairs and to express distrust of C.F. White. In a letter dated 5 April 1890, George offered to invest £500 in

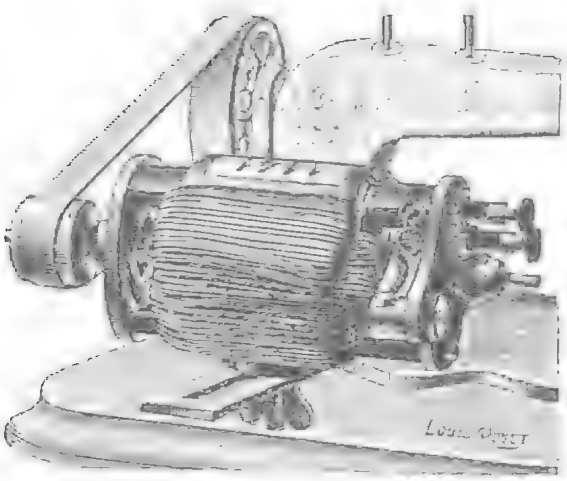


FIG. 32. Sewing machine driven by a small battery operated electric motor. Barton, White and Co. exhibited a similar device in 1891.

the firm and this was accepted in May. At the same time, T.E. White, brother of C.F. White, pointed out to George Barton that he and others had lent or guaranteed over £2000 and that Barton senior's investment, though accepted, was not welcome. (93)

In August 1890, the Annual Show of the National Agricultural and Industrial Association of Queensland included an exhibit by Barton, White and Co. The electrical apparatus included a dynamo and, as an example of the application of electricity to industrial uses, a small motor-driven printing machine. (94)

During 1891, the firm continued to extend the electricity supply side of their business and it was reported (95) that 'they now have power for 600 lights'.

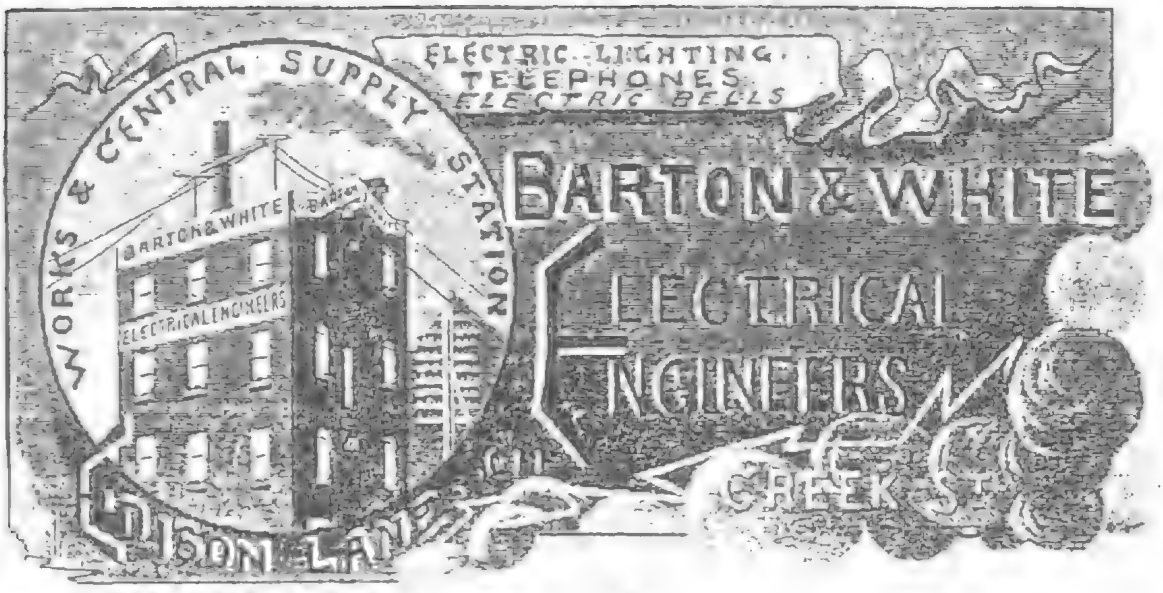
This was the development claimed by Barton in his evidence regarding the Brisbane Gas Company Amendment Bill. The above report stated that the firm had manufactured for the Queensland Turf Club an electrical signalling apparatus for recording at the Eagle Farm racecourse. —

> The power is obtained from LeClanché cells and carried into two coils with a check armature. On the button being pressed, the armature is drawn to the magnets and releases a ratchet wheel which turning strikes a large gong and on the placard shows the race starting, the dividend from the totalisators and winners as the case may be. The ingenuity and workmanship reflect great credit on the firm.

A little over three years after the disastrous fire at the Exhibition Building in Brisbane, Barton, White and Co. were entrusted with the lighting of the main building and concert hall sections of the premises. This required 10 arc lamps equal to 30,000 c.p. and some 200 incandescent lamps. The arc lighting was provided from a Crompton dynamo (500 V., 15 A.) and the incandescent lighting from a more powerful dynamo of the same make (110 V., 90 A.). The following description (96) of the display which was arranged after completion of the lighting gives some idea of the versatility of the firm as well as the progress made in their early efforts to popularise the use of electricity.

> . They have a small dynamo used for driving motors in various parts of the building and they show a motor developing 2½ h.p. ... In the main hall they have an extensive show of electric appliances including bells, fire alarms, telephones . Other examples of the application of electricity to motive power are illustrated by an automatic electric mining hoist working in connection with a safety cage, a lathe driven by an electric motor, an electric weighing machine which delivers a printed slip on placing a coin in a slot and many other useful machines such as sewing machines (Fig. 32), printing presses etc. A great attraction was Edison's latest phonograph (Fig. 33) ... by means of this instrument visitors were enabled to hear reproductions of the voices of eminent statesmen and musicians .

FIG. 33. Edison with his phonograph in 1888. A similar phonograph was imported by Barton in 1891. When displayed at the Brisbane Exhibition, it was fitted with 12 pairs of earphones so as to enable 12 listeners to be entertained at once.



A

BARTON & WHITE.

ELECTRIC LIGHT, ELECTRIC MOTORS,

Electric Bells, Lightning Conductors,

TELEPHONES. ELECTRICAL SUPPLIES.

Edison-lane, off Creek-street, Brisbane.

(Entrance next Post Office, Brisbane)

B

Fig. 34. A, letterhead of the newly-named firm of Barton and White, probably drawn by Barton. B, advertisement for Barton and White, 1892.

Further details of the phonograph are given in an account by A.G. Jackson, (97) at that time an employee of Barton, White and Co., the firm having brought the first Edison machine to Brisbane. —

> It was run by electricity supplied by batteries and cost something like £200. In one week's demonstration during Exhibition Week, 1891, Barton, White and Co. got their money back — and something to spare. They fitted a dozen 'earphones' [each] resembling a doctor's stethoscope [with] two metallic terminals fitting right into the ears of the customer. When business was brisk the customers heard only half a record before being bustled out of the way to make room for other patrons — and at 1/- a time.

The playing time of a record was 2½ minutes. Jackson also mentioned (97) a tour of the State with the phonograph —

> the tid-bit of the evening [was] the recording on a wax cylinder of the speech of the presiding Mayor or other dignitary. It was then immediately played back to him to the obvious delight of the audience.

Barton himself was very interested in the equipment and gave a paper and demonstration to the Queensland Institute of Mechanical Engineers at this time. (98)

In July 1891 there came the first sign of intended regulation of the electricity supply industry in Queensland when the Post and

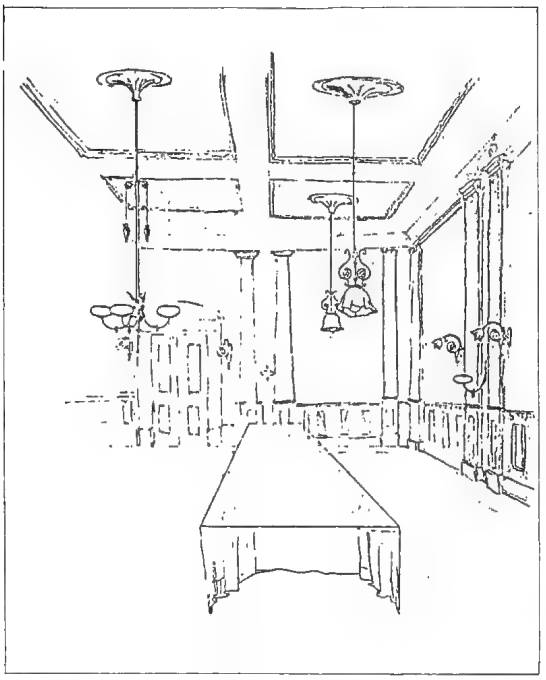


FIG. 35. Proposal by Barton for the lighting of the dining room in the Parliamentary buildings, 1892. Gas fittings, as on the left, were to be retained and the electric light fittings were to be arranged separately. The earlier installations in these buildings were carried out by attaching the electric lights to the gas fittings.

Telegraph Bill was passed. This gave the Government power to establish safeguards in connection with electric lighting and the transmission of electric power. (99) In the following year a Bill 'to prevent Electric Lines being constructed or used in such manner as to injuriously affect Telegraph Lines' was drafted but by 1895 it had still not been introduced to Parliament. It is safe to assume that the current practices remained more or less unchanged until the implementation of the Electric Light and Power Act of 1896, of which more shortly.

In 1892, presumably for commercial reasons, the name of the firm was changed from Barton, White and Co. to Barton and White without any evident alteration in activities. (Fig. 34) They continued to develop the distribution system in the central part of Brisbane and in November of that year it was reported that the firm had 'some eighty consumers on their list.' (100) This development was still without authority other than permission by the Mayor to make minor extensions from time to time. (89)

Not surprisingly many members of the Brisbane Municipal Council were against this piecemeal growth of the supply system and felt that electricity should be the responsibility of the Municipality. This was particularly the case because they considered that they had prevented a monopoly for electricity supply being given to the Brisbane Gas Co. Ltd by their opposition to the Amendment Bill in 1890. In their opinion an Electric Light and Power Act should be introduced by the Government, the intention being to control the supply of electricity by means of Orders in Council with the possibility that the Brisbane Council itself might wish to obtain such an Order. The Chief Secretary (Sir Samuel Griffith) promised that he would endeavour to find time to prepare a Bill embodying the necessary regulations which he would submit to Parliament. Apparently Sir Samuel did not find time, for no Bill was forthcoming. In 1893, the Mayor summed up the position (88) in these words —

> And thus we stand, the Chief Municipal Council in the Colony, unable to move forward one step in this direction until it pleases the powers that be to graciously accord us permission, while private firms wire the principal streets from end to end and supply electric light and power without let or hindrance.

So Barton and White continued to provide unauthorised electricity supply for Brisbane for the next few years.

In 1892, Barton, White and Co. undertook the underground cabling and inside wiring for the new wing of the Parliamentary buildings, the lighting fittings being manufactured by Trackson Bros, Brisbane. Fortunately a description of the trial of the new work was given in a contemporary newspaper. (62) —

> The dining, smoking and Ministers' rooms were lit up, but the light in some of the rooms was not quite up to expectation, as the lamps were of the old pattern 16-candle power, which it is intended to replace with 32-candle power now on the way out from home. The lights in the dining and smoking rooms were very brilliant, as were also those in the Assembly Chamber. The trial was considered satisfactory, as the only defect noticeable was in the lamps. The current is supplied by two 400-light dynamos of the Edison pattern, which are placed in the electric room of the Government Printing Office. These are run at 1000 revolutions per minute, and require about 60-

horse power to supply the 400 lights at the Parliament House. ... The current is distributed by cables placed in the roof of the new wing, which are connected with similar cables in the main building. Suitable fuse boards with safety 'cutouts' are connected with the cables. All the wires in the building, after branching from the cables, run under the floors of the passages, and distribute thence to the chandeliers. Each room is provided with a switch attached to the wall, and close to the door, so that a person entering the room can at once turn on the light as he enters. The dining room is lit by twelve double brackets, and four pendants. The brackets have switches to each light, and the whole of the pendants are controlled by one switch. In all there are 130 lights in the new wing of the House. ...(Fig.35)

Other work carried out in the same year was the lighting of the new works of the Queensland Meat Export and Engineering Co. in Brisbane. The Crompton dynamos were supplied by Barton and White and the switchboards manufactured in their workshops. (101)

MORE INTEREST BUT SERIOUS FINANCIAL PROBLEMS: Finance had become an increasing problem for the firm and there were many exchanges of letters between those giving financial support in Brisbane and Barton's father — now Judge Barton — in New Zealand. In June 1892 T.E. White wrote to Judge Barton indicating that still more money had been lent to Barton and White but added that 'they were doing well just now.' However it seems clear that the Judge wanted repayment of the £500 lent in 1890. In mid-October C.F. White protested about this pointing out that to repay the loan meant increasing the firm's indebtedness to T.E. White. The letter mentioned an electric shearing machine which had proved a failure commercially. (102) This had been patented by T.E. White and the partners in 1891. (103) C.F. White summed up the position by saying that Barton and White owed currently £4700 made up of £500 to their bank, £500 to Judge Barton and £3700 to Alfred Shaw and Co. All of these sums were guaranteed by T.E. White 'so of our liabilities he is responsible for roughly £5000.'

In August 1892 Barton and White again exhibited at the annual show of the National Agricultural and Industrial Association of Queensland and a report (104) stated that —

> on no previous occasion has the display of electrical appliances ... been so large and so varied as it has this year.

Referring to Barton and White the report

FIG. 36. Medal awarded to Barton and White by the National Agricultural and Industrial Association in August 1892. The exhibit was a water level indicator for a pumping station.

noted the number of locally made articles as the most striking feature —

> including a dozen electric motors and fans for cooling rooms in summer.

Further items were listed as follows —

> a water level indicator for showing (in the engine room of pumping works) the water level of a reservoir at a distance; a prismatic compass indicator for taking bearings of stars and lighthouses at sea; an electrical pressure gauge,

FIG. 37. Electric butter making plant at the Pine River Dairy Factory, Brisbane in 1894. This comprised a concussion churn on the left and a circular power butter worker, in the centre. The plant was stated to be the first in Australia and was installed by Barton and White.

called a voltmeter, for indicating the electrical pressure on the mains for electric lighting. In the grounds the firm had erected a complete plant for electric lighting having a capacity of 300 lights and consisting of a steam-engine, boiler, two dynamos and the necessary belting to connect them. The current from these dynamos was utilised in the building for running the ten motors and for lighting a number of other exhibitors' stands ... adding materially to the brilliant effect. The firm also illuminated their own stall with electric lamps among which we noticed several large incandescent lamps of 200 candle power. The [Edison] phonograph formed an important feature of this firm's exhibit and was the centre of much interest, the latest songs and instrumental music proving very interesting. The firm exhibited the usual assortment of electrical goods in the way of bells, batteries, wires etc and, of their own manufacture, they had a large handsome [room] indicator which they had made for the Leichardt Hotel at Rockhampton. A watchman's tell-tale clock was shown made for recording the progress of a watchman on his rounds during the night, there being electric punches at various points on his track which he has to punch, sending thereby a current to the clock where it registers by a mark on a paper dial divided into hours by radial lines. Some medical batteries of an improved type were also shown. In electric lighting the firm had a display of ornamental shades and fittings ...

When the awards were announced, Barton and White received a first order of merit and were recommended for a medal for their water level indicator for use at the Mt Crosby pumping station; also a first order of merit for their exhibit of an Edison phonograph and electric motors. (Fig. 36)

THE 1893 FLOODS — A YEAR OF CHANGE: The financial difficulties were greatly exacerbated by the two disastrous floods that occurred in Brisbane in February 1893. The effect on Barton and White was catastrophic because the flood water rose just above ground floor level of the Edison Lane building. Hence the engine room in the basement was flooded. The only relief was that, as the gas works were also out of action — and remained so for five days, the Colonial Secretary allowed the firm to take supply temporarily from the Government Printing Office plant in William St which was above flood level. (105) When the second flood occurred in the same month, Barton and White set up a portable engine and dynamo at a site above flood level at the top of Edward St and continued to give supply until the plant at Edison Lane could be repaired. W.M.E. L'Estrange remarked (55) in 1934 that 'the demand for electricity became definite from this time.'

In fact in March the firm reported that 'electrical business seems to promise

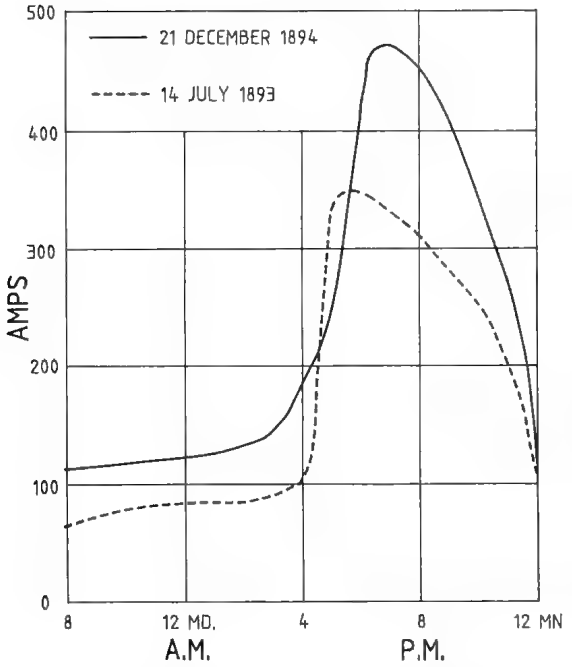


FIG. 38. Daily load distribution diagrams showing the variation in electrical loading of the Barton and White, Edison Lane power station for a winter day in 1893 and a summer day in 1894. The plant operated from 8 a.m. to 12 midnight but could not be used economically for lack of demand during daylight hours. Assuming a service voltage of 110, the peak loads were 39 kW and 51 kW respectively.

improvement' although the only new work mentioned was the fitting of the dredge 'Hydra' with electric light to enable it to work by night as well as by day. (105)

An interesting sidelight on the operation of the power station at Edison Lane was recorded in 1938 by A.B. Corbett who had been employed for a few months assisting with the repair of flood damaged equipment —

> ... The G.P.O. Mail Branch was the first customer of Barton and White whose power station now is portion of G.P.O. property. It was a primitive affair judged by today's standards. The horizontal boiler was fired with logs of wood and I can remember assisting 'Bill' Young when he as fireman had a green log in the fuel box, the fire was going out, steam dropped to 20 lbs, and Bill could not get the log out. The Mail Room employees by knocking on the wall drew attention to the fact that the lamps were practically out and what steam there was was probably maintained by the remarks of Bill Young and myself on the ancestors of the contractor who supplied green logs for fuel. I remember the fuel contractor's name was Burns. (1,97)

Street lighting by electricity was still under active discussion and in the midst of the flood problems Barton and White submitted a tender to the South Brisbane Municipal Council. This was for 50 lamps between Victoria Bridge and The Fiveways at Wooloongabba. The rate per lamp was to be £6 p.a. for a term of three months reducing to £5 for 24 months. After exchanges about variations to the proposal, the tender was rejected and a contract with Trackson Bros approved. However work started without the contract being signed and after several lamps had been erected Trackson Bros sought an extension to the time specified and this seems to have been an excuse for not proceeding further with electric street lighting. (105,106)

C.F. White remained a partner until 1893 but what little is recorded about him suggests that he did not take a fair share of responsibility. This can also be inferred from the following extract from a letter written on 22 November 1897 by Barton to W.M.E. L'Estrange —

> I shall give you a history ... from the time that I got rid of White i.e. from June 1893. As you know, up till then I had charge of the work and White managed the finances with the result that after 6 years of work the firm owned a plant that cost £4000 and owed about £8000 of which the greater part was bearing interest at the rate of 9 per cent per annum. (107)

In July 1893, Barton acquired from A.G. Jackson — an ex-employee — the right to manufacture Coin Fed Automatic Galvanic Machines. These were penny in the slot electric shock machines which were set up in various hotels. According to G.G. L'Estrange —

> these were very remunerative until they were declared a public hazard and forfeited to the Crown. The loss of these machines led to Barton and White's first failure to meet their creditors. (71)

In spite of the additional financial difficulties caused by the floods, Barton married in 1893 at the age of 34. At a ceremony held on 13 September at the Registry Office, Brisbane he married Mary Allan Sutton, second daughter of Joseph William Sutton, coppersmith, and Mary Sutton (nee Hurley). Sutton was head of a large mechanical engineering firm (Sutton's Foundry) and had a wide variety of activities. Barton had

a close link with him through their common interest in the Technical College which was part of the School of Arts at that time (see later).

It is interesting to note that from July 1893 — the post-White period — Barton and White's weekly advertisement in the *Queenslander* changed from one advertising electrical services to an announcement that they were now sole agents for Smith Premier typewriters, at £22 each. (108) In December of the same year the firm changed its advertising to a more subtle form. A short paragraph — a hundred or so words — in the news section of the paper described a particular service offered to the public, e.g. electric lighting of sugar mills which allowed them to run night and day during the season. In this case the advertisment read as follows —

> The electric light was adopted some twelve years ago in Queensland by some enterprising planters for lighting their sugar mills but defects in the apparatus and want of experience caused the new light to fall into disfavour. Since that time great progress has been made in the design of the dynamo and in the manufacture of lamps, holders, cutouts, switches etc, while the lapse of patents has reduced the price of all that apparatus by half. Hence the electric light has now come into favour again, especially among sugar mill owners. In the Isis Scrub the credit belongs to Messrs Robert Cran and Co. of being the first to introduce the new light, and they appear well pleased with the results at their Doolbi mill. Messrs Barton and White of this city, who supplied and erected the plant, have received a letter from them expressing their satisfaction in no measured terms. (Advt) (109)

The subject of this type of advertisement was changed weekly to cover six topics, the other five being: Lightning Rods, The Electric Fan, The Telephone for Stations, Fire Alarms, Electricity Supply for Towns. The series continued for about a year after which the firm appears to have ceased advertising in the *Queenslander.*

1894 — THE NEED TO EXPAND: An interesting record of the enterprise of Barton and White appeared in the *Queenslander* of 3 February 1894. This was the use of an electric motor to drive butter-making machinery (Fig. 37) described as 'the first electric butter-making plant in Australia.' The Pine River Dairy Factory was in Edward St, Brisbane and the cream was sent by rail from the Pine River district. The article explained that it is impossible to use mechanical power except in factories of very large dimensions. In small factories 'the heat given off by both steam and gas engines would militate considerably against successful working, and everyone ... is aware that it is inadvisable to allow the fumes of burnt gas or heated oil to enter the building ...' There are a few other records of the activities of Barton and White for 1894. In May they reported that the full power of their plant was required to supply the increasing demands of the city for electric light. (110)

During 1894, and possibly earlier, Barton considered diversifying his firm's activities by providing cold storage in the vicinity of the Roma St Markets. This plan was to include moving the Edison Lane generating plant to the same site. There is a reference to the cold storage proposal in July when it was reported that the firm was establishing this near the railway gates for the convenience of farmers and other dealers in perishable products. (111) This report was premature as Barton was still negotiating with the Brisbane Municipal Council regarding renovation of a building for the proposed development. (112) The negotiations evidently failed although in August 1895 Barton was still calculating the economics of a 2000 light station and a refrigeration and ice-making plant. (68) The announcement in the same month that Mephan, Ferguson of Victoria had had their tender for cold storage at Roma St accepted by the Railways Department concluded the matter. (113)

In August 1894, at the Queensland National Association Annual Show, Barton and White exhibited an electric hot water heater, a 2000 c.p. arc searchlight, a combination ventilating fan with motor and an igniting system for firing explosive mines. (114)

Behind these plans and the display of power consuming devices was the continuing concern that the generating plant and distribution mains were not being used efficiently. It is a basic problem in providing electricity supply that the demand is not spread evenly over the period during which supply is available — at this time in Brisbane, from 8 am to 12 midnight. This uneven demand is shown in the load distribution diagrams (Fig. 38) which were typical of a winter's day in 1893 and a summer's day in 1894. (68) The peak loading occurred in the evenings when domestic lighting would have been a main factor. One objective of the firm would have been to increase the use of electric motors in industry and thus help to

use the surplus generating capacity available during daylight. In technical terms this would mean increasing the 'load factor', the ratio of the average load to the peak load over a period; but of course the cost of electrical energy was the major obstacle to rapid development.

A record of the charges for lighting in Australia was given by Anderson in a survey of the Eastern States in 1893 —

> The price charged in Victoria for an incandescent light varies from 6d. in some of the country towns to 1/6 per week in Melbourne. In Sydney the price is 1/- per week, and in Brisbane, where there is no competition, the price is 1/9 per week. You can reckon that the average price (except [in] Brisbane) is 1/- per week or 4/- per month. (115)

The lamp size in Anderson's survey is not known but was probably 16 c.p. It should be noted that later the charge in Brisbane was reduced to 4/- per month for a 16 c.p. lamp.

A YEAR OF UNCERTAINTY: There was still no action by the Government towards legalising electricity supply although the Brisbane Municipal Council continued its efforts to have legislation provided so that it could engage in the electricity supply business in 'a substantial and satisfactory manner.' (88) In spite of this situation the year 1895 proved to be one of considerable development by Barton and White although as will be seen shortly it concluded with a decision to offer to sell the plant to the Council. There were evidently more consumers than in previous years since in February it was reported that the firm —

> have recently extended their cables to supply electric light at a greater distance than hitherto. The farthest lights they supply are half a mile away from their premises and are worked on a three-wire system. (116)

In March, Mr G.D. Hamilton, whose previous connection with developments in Queensland were mentioned earlier, gave a newspaper interview and subsequently was asked to comment on progress since 1882 in which year he was in charge of the December electrical illuminations. From his inspections he estimated the number of premises lit by electricity as eighty-six excluding Government buildings. The Courier building had 300 lights supplied by their own plant and there were about 700 elsewhere supplied presumably by Barton and White. Hamilton advocated electric arc lamp lighting of the main streets with the lamps 150 yards apart and about 22 ft high. As a comparison he stated that an ordinary street gas lamp is 12 c.p., an arc lamp, 1500 c.p. He favoured incandescent lamps in smaller streets. Questioned about fire risk from electricity installations he considered this almost nil. However, he hoped to see electricians licensed so as to prevent incompetent men trading on the public. He considered that the most serious obstacle to greater use of electricity in Queensland was the duty charged on patent goods and articles which could not be made in the colony for some years to come. The current rate was about 25 per cent. (117)

One of the obvious successes of Barton and White was the manufacture and sale of cooling fans. They had already sold 30 or 40 and were making 40 more in preparation for next summer. A contemporary description said that —

> they have been known to run for 6000 hours without attention beyond oiling once a week. They are shaped like a ship's propellor and revolve at 2000 revolutions per minute producing a steady breeze. (118)

The firm undertook armature winding of dynamos and motors and it was noted in August 1895 that they were just finishing the winding of three armatures for the British India and Queensland Agency Co. This involved laying down 'a special plant in the way of wire-covering machines to utilise the wire removed from the machines.' (119) Barton and White again exhibited at the National Association Annual Exhibition showing a dynamo of 150 lights capacity — presumably of their own manufacture — for use in a mine. In November 1895 it was reported that they had just finished a magnetic separator for wet separation of ores for a gold mine 'in the north'. Separation of magnetic material from ore bodies was at that time usually carried out in the dry state after concentration. The wet process enabled the magnetic material to be removed as it came from the mills or stampers. The separator was evidently a success as a second one was ordered by the same customer the next month. (120)

Concurrently with these activities there had been a great deal of correspondence between Judge Barton and Edward about the financial problems of the Company. (121) The Judge made many proposals intended to deal with the difficulties, often shown in balance sheet form. One of the more remarkable was that he and his son should become partners, the Judge having offered to sacrifice almost all his assets to meet

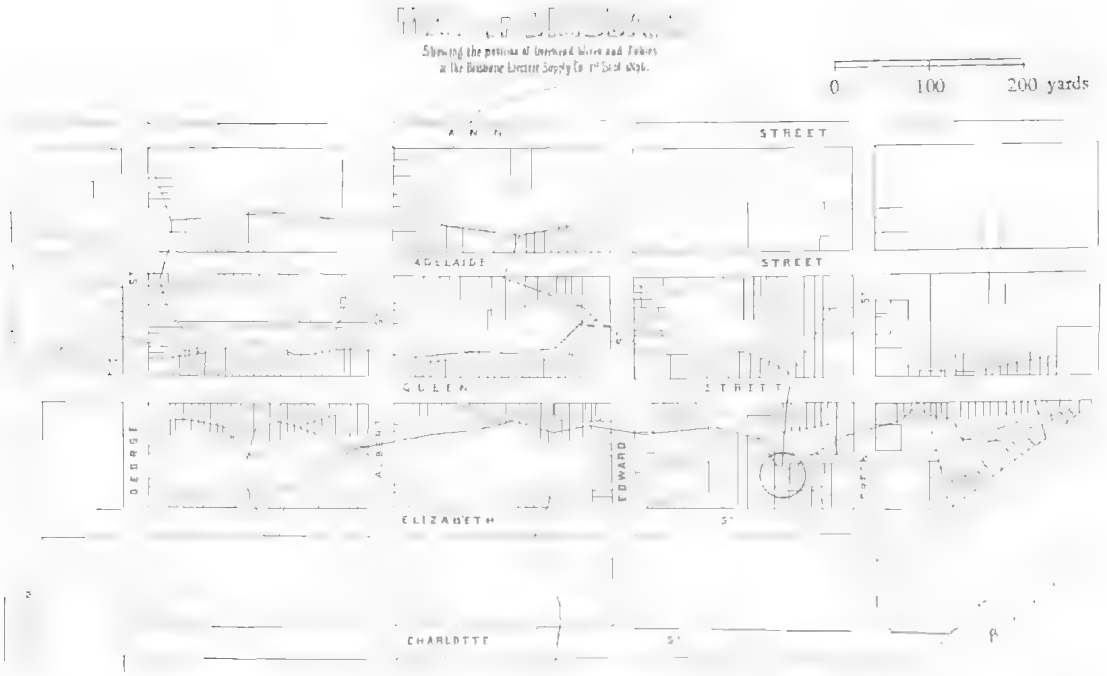


FIG. 39. Brisbane Electric Supply Co. Ltd distribution system showing the position of the eight miles of overhead lines in 1896. The system voltage was 220/110 volt, 3-wire, d.c. The lines were insulated and described as 'attached to and crossing buildings.' The Edison Lane power station, with a stated generating capacity of 60 kW, is identified by a circle.

part of the firm's indebtedness to creditors. This situation assumed insolvency and a probable payment of 10 shillings in the pound. An alternative with much the same result was to have a company formed with the two mentioned above and five Barton relatives. The Judge and Edward were suggested as perpetual Directors and Managers. In spite of the apparent generosity of these proposals, neither was accepted by Edward.

In late 1895, the firm offered to sell their electric lighting plant to the Brisbane Municipal Council for £4000. (122) The supporting argument was that they had built up a business worth £3000 p.a. in the face of many difficulties and now had 92 consumers. The return could be 'greatly augmented by increasing the generating energy.' It was also pointed out that the Council was paying the Brisbane Gas Co. £3000 p.a. for street lighting. The City Engineer was instructed to prepare a report with relative costs of lighting the city with gas and electricity. In the event the Council decided to do nothing pending the long-promised Government legislation defining their powers in this matter. (88)

BRISBANE AREA, 1896 TO 1905

BARTON AND WHITE BECOMES THE BRISBANE ELECTRIC SUPPLY CO. LTD — THE ELECTRIC LIGHT AND POWER ACT: The events of 1896 changed the future of electricity supply in Brisbane in two ways. Firstly, it had become clear in 1895 that Barton and White were in a hopeless position financially and that insolvency was imminent. The solution was the formation of a new company. Secondly, under the provisions of the Queensland Electric Light and Power Act, passed in December 1896, electricity could be provided legally.

A meeting of creditors of Barton and White held on 3 January 1896 to discuss the crisis agreed to liquidation by arrangement. (123) The unsecured liabilities were quoted as £7666 — largely owing to banks — and the assets as £3783 — mainly the Edison Lane power plant and stocks. The reason for insolvency was said to be insufficient capital and depression of business. It was stated that the electricity supply part of the business 'could just hold its own' but the appliance side involved a weekly loss; this in spite of the firm's versatility. (124)

Mr G.S. Murphy, an accountant, was appointed as the Trustee for the estate of Edward Barton and Frank White and on 10 February the Supreme Court of Queensland issued a Certificate of Discharge. Barton then purchased the business for £1500 although immediate payment of this was not required. He was given full control as manager during the ensuing six months and electricity supply was continued without interruption. In fact, as Barton explained 'the plant earned over 6 per cent of its capital outlay' for this period. He sought to raise capital in Brisbane and Sydney without success but finally 'a few intimates who knew and had confidence in the concern' purchased it for £400 cash and about £1100 in promissory notes. These supporters were mainly members of the original firm and, as further evidence of loyalty, two contributors were wives (Mrs Young and Mrs Ward). (125) The promissory notes were to be met over the ensuing 18 months, as indeed they were. (107)

Thus the Brisbane Electric Supply Co. Ltd was registered on 2 September 1896. The Directors were: Messrs E.J. Holmes, E.G.C. Barton, W.J. Young and A. Ward, all but Mr Holmes (an accountant) having transferred from Barton and White. The initial capital was £5000 although in March 1897 this was increased to £100,000 by the creation of 95,000 new shares. (126) It had been decided in June 1896 that the name Barton and White would be retained for the manufacturing and repair work carried out by the firm and this was to be the responsibility of W.M.E. L'Estrange. He was required to pay £1 per week for the use of the upper floors at Edison Lane and £1 as a single payment for the use of the name. At the same time Barton raised a long-standing objection to the rental of the property, leased in 1889, and succeeded in having it reduced from £4 6s 6d to £2 15s. At last Barton was paid a reasonable salary — £350 p.a. — in contrast with the situation a few years before when, as he commented to T.E. White, (127) for five years he had lived on £150 p.a. (from the Queensland Government) and an average income of 15 shillings per week from the firm.

There was still the matter of settlement of accounts with creditors at the time of insolvency. By 1898 four distributions totalling just under 4 shillings in the pound were concluded.

The Queensland Government decided early in 1896 to invite applications for the position of Queensland Government Electrical Engineer as there had been no replacement for Barton since his part-time appointment was terminated in 1894. John Hesketh, whose previous experience had been as electrical engineer to the Borough of Blackpool, England was selected from 75 applicants and appointed in May 1896. His responsibilities were to advise the Government on all matters connected with the telegraph and telephone systems as well as to deal with questions of electric lighting whether undertaken by the Government, Municipality or private parties. His salary was £600 p.a., over twice that offered to Barton ten years earlier. (128) He also had the right of private practice, as approved. Soon after commencing duty in July he would have found that legislation regulating electricity supply was urgent and it is very likely that he sought Barton's advice in the discussions that followed.

There had been a great deal of controversy in Great Britain following the passing of the Electric Light Act in 1882, a measure brought in by the Government to regulate the previously uncontrolled growth of electricity supply. Hesketh no doubt took full account of the British problems of the past fifteen or so years and of the Amending Act of 1888 in advising the Queensland Government both in the drafting stage and in regard to the amendments proposed before the Queensland Act became law. After a series of alterations recommended by a Select Committee of the Legislative Council, the Electric Light and Power Act was passed in December 1896. The Postmaster-General in bringing down the legislation stated that —

> under this measure the public interest will be fairly well protected and the people who invest their capital in electric lighting will have more assurance that their works will be protected on safe and sound lines. (129)

The Act provided that any local authority, person or company might by Order in Council be authorised to supply electricity in a specified area. It set out their powers, duties and obligations, provided for the protection of other public utility equipment e.g. telegraph lines, dealt with conditions for the supply of electricity, the recovery of charges, the purchase of undertakings by local authorities and made provision for regulations and by-laws governing electricity supply. Each Order under the legislation had to prescribe the limits within which, and the conditions under which, a supply of electricity was to be compulsory or permissive. The Act also allowed local

FIG. 40. Cartoon in 'The Worker' newspaper of 9 January 1897. It illustrates the hostility of some members of the Brisbane Municipal Council to the overhead lines erected in Brisbane by the Brisbane Electric Supply Co. Ltd. The Electric Light and Power Act of 1896 required future mains to be underground. The comments read: Mr Clarke — 'If I were in the Municipal Chair the post would come down within six hours.' 'The City Council was rapidly losing its powers and bye and bye this company would get its octopus claws on so much that the Council would simply be a collector of rents and a levier of taxes' (*Courier*)

authorities the right to acquire an undertaking in its area by compulsory purchase within six months after the expiration of 42 years or such shorter period as might be prescribed by the relevant Order, or at the expiration of every subsequent ten year period.

THE FIRST ORDER IN COUNCIL: The first Order in Council was issued to the Brisbane Electric Supply Co. Ltd, effective from 12 May 1897 and the area over which they had a monopoly of supply was a small part of North Brisbane adjacent to the Post Office, an area much less than a tenth of a square mile. The Order extended for a minimum of 42 years and under it the Company incurred heavy responsibilities for laying down plant and mains including the requirement to replace overhead mains by underground cables within a year. The undergrounding of mains was a legacy from English legislation. A further requirement of the Order was to observe a maximum energy charge. This was set at 10 shillings for the first ten units (kWhs) and then one shilling per unit.

Prior to the issue of the Order, Hesketh had sought information from the Company regarding their plant, present and proposed, and area of supply. The following is from Barton's reply (130) showing the Company's position on 1 September 1896 —

> Steam Plant; 3 Boilers, 3 Engines, indicated capacity 120 horse power.
> Electrical Plant; 4 Dynamos, total capacity 60 kW.
> Distributing Plant; 8 miles of overhead conductor, distributing capacity 300 kW.

Barton also included a diagram (Fig. 39) showing the extent of the distribution system at the same date. Further a list of 'Works Commenced' was given which suggested an increase in capacity of the electrical plant of more than four times was envisaged. In the event, it proved to be a long term forecast since it was six years before it was achieved, at a new site. Details of the plant have been difficult to discover but a letter by Barton dated 6 August 1896, (81) gave the details of each item thus —

> Dynamos; 1-Crompton, 110V., 250A.; 1-Crompton, 115 V., 100 A. 1-Brush 'Victoria', 110 V., 100 A.; 1-locally made, 110 V., 70 A.
> Boilers, locomotive type: 1-Marshall; 1-Dubo; 1-Shanks
> Engines; 1-Marshall, twin cylinder; 1-Marshall, single cylinder; 1-Shanks, twin cylinder.

A recently found inventory of the Edison Lane equipment includes two horizontal steam engines of 8 and 14 nominal h.p. respectively.

UNDERGROUND CABLES TO REPLACE OVERHEAD WIRES: Cables for the undergrounding of the distribution system were ordered by the Company and in November 1897 were 'underway from England'. Barton recorded that in the small area granted to the firm —

> they will cost less than £2000 to supply a total connected load of 125 kW (equivalent to 5000 lamps of 8 c.p. [sic]) whereas in a suburban area the cost would have been about £7000. (107)

The type of cable which had become available at this time was lead-sheathed, three core, paper insulated and laid as a complete entity, the earlier Edison 'street tubes', laid in short

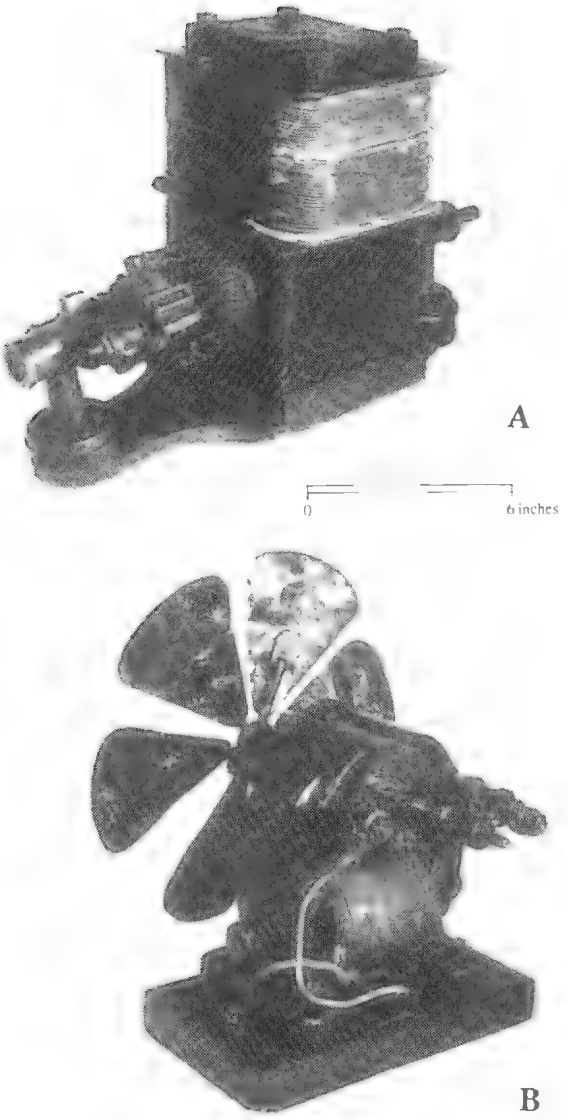


FIG. 41. Examples of electrical devices designed by Barton and manufactured by his firm. **A**, a fractional horse power motor and **B**, a small fan. (Queensland Museum Collection)

lengths, now being obsolete. An account by G. Mackenzie, a Company apprentice at the time, stated that the first of the new underground cables were installed under the pavements along George St and Queen St. They were laid in hardwood troughs and covered with bitumen. Service to consumers was given by lead sheathed connecting cables soldered to the mains, the lead sheaths being bonded together. An ironclad fuse box was fitted at the other end of the service cables. (80)

Apart from complying with the provisions of the Act, the undergrounding met one of the objections of the Brisbane Council who earlier had, according to W.M.E. L'Estrange 'very nearly harassed the new company out of existence.' He recalled that —

> in 1895 the Council advertised that the Company's [overhead] cables were illegal, and the financial position of the Company was made almost impossible because of this. The following year the Council threatened to cut down one section of the cables, and the Company was therefore forced to remove it. (55)

G.G. L'Estrange, son of W.M.E. L'Estrange, stated that —

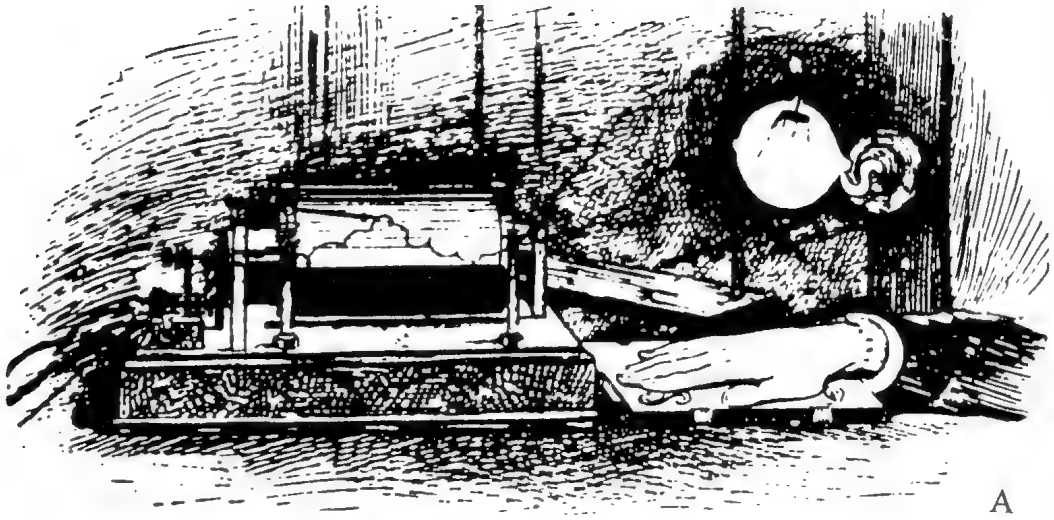
> as an indication of the feeling at the time, the *Worker* newspaper of 9 January 1897 published a cartoon depicting an octopus, with electric light bulbs as eyes, to represent the Brisbane Electric Supply Company climbing an electric light pole with the local town councillors, including the Mayor, in attendance with axes, prepared to destroy the octopus (Fig. 40). This led to the Company being branded 'The Octopus', a name which unjustifiably remained until quite recent times. (71)

The antipathy should have ceased when the Order in Council was granted to the Company since there was a requirement that overhead wires be removed by May 1898. Because of delays in installing the new underground cables, the Company sought an extension of time to 1 January 1899 and this was granted by the Government. However further problems arose and an extension to 31 July was requested. Finally 14 April was agreed to by both parties.

INSTALLATION AND MAINTENANCE WORK ON A TIGHT BUDGET: The Company continued with installation and maintenance work, general contracting and the manufacture of all kinds of electrical apparatus. Nearly all the installations were wired with 'V.I.R.' (vulcanised india rubber covered copper wire) enclosed in wooden casing or supported on insulators; others used twin lead covered 'Henley' wire. According to Mackenzie —

> the Company could never have existed on current sold to the consumer, the main source of revenue coming from installations in the country — meatworks, Government work, sugar mills ...

He mentioned that the firm had practically the monopoly of repairs to ships' installations for which the generators, switchboards and appliances were made in the Company's workshop. Mackenzie's remarks must have



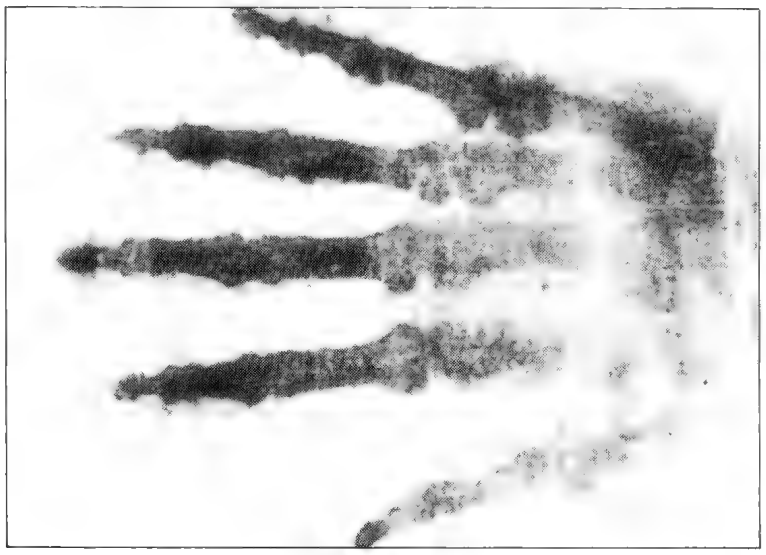


FIG. 42. A, type of apparatus used by J.W. Sutton of Brisbane to give the first demonstration of X-rays in 1896. The basic items were a primary-battery operated induction coil and a Crookes vacuum tube. B, X-ray of a hand taken by Mr Sutton in 1896. The radiograph was recorded on a photographic plate placed under the hand. Exposure was for 9 minutes.

applied to the period prior to insolvency since at the time of the insolvency the main source of revenue was said to be from the sale of energy. Referring to general maintenance work, Mackenzie also recalled that there were persistent problems with the lamps, starting with the early days at Edison Lane. All lamps were of the carbon filament type and a thin deposit of carbon gradually built up inside the glass. To compensate for the resulting loss of illumination the voltage was raised with consequent increase in fuel cost. In view of this it was found to be economical to replace free all the lamps every six months.

> On lamp change day, as it was called, everyone who could be spared was put on the job as all lamps had to be changed on the one day because the voltage had to be dropped. Any lamp not done would be dull and cause complaint. (80)

Barton would have been responsible for the detailed design of items developed and manufactured by the firm and there is evidence

of this in a Work Register of the period. (68) This contains his sketches and calculations for a variety of apparatus as well as the results of tests made on the premises. A list extracted mainly from the Register is given in Appendix B and some items are held by the Queensland Museum. (Fig.41)

As an example of the firm's versatility it is known that they carried out X-ray work for a Brisbane doctor, Dr John Thompson, probably in 1896 or a little later. The first demonstration of X-rays in Brisbane was given by J.W. Sutton, Barton's father-in-law, so it is very likely that Barton himself was involved in this and subsequent developments. Mr Sutton's demonstration was held in July 1896 before a small group of leading doctors and repeated in August at a public meeting of the Royal Society of Queensland. (131) (Fig. 42). An early example of the use of X-rays in medicine in Brisbane is given in the Australasian Medical Gazette of 1897 when Dr Wilton Love took X-rays for Dr Thompson so as to locate a pea-rifle pellet imbedded in a child's foot. (132,133)

In spite of the many activities of the Brisbane Electric Supply Co. Ltd and the possession of a long-term franchise, the last years of the century presented financial problems. W.M.E. L'Estrange, who had first hand experience of them, wrote as follows —

> The early days of the Brisbane Electric Supply Co. Ltd were ones of continual worry, particularly in regard to finance. Times were strenuous and money scarce. Electric light was an innovation and the investor shy, more especially as the unceasing opposition of the Government and the Council made security of tenure an unknown quantity. The wages paid to the staff were nominally so much per week but on many a pay day the employees held an informal meeting of [staff] shareholders to decide on how little each one would need to carry on until the next week when it was hoped times would be better. More often than not the pay cheque was drawn and cashed at the Belfast Hotel or Royal Hotel (who were consumers of electricity) last thing on Saturday, after banking hours, so that the wages could be paid, then first thing on Monday morning the Manager and the Secretary started on a hurried tour of the Company's debtors to get enough money into the bank to meet the cheque when it was presented. There are many tales which could be told of wives who fearfully saw their small houses mortgaged to find capital to carry on the Company; of money raised on insurance policies for the same end, and such like. (55)

MUNICIPALISATION OF ELECTRICITY SUPPLY — A LOST CAUSE: Because of pressing financial problems, the Company continued in its efforts to sell their undertaking to the Brisbane Council. However the Council did not wish to acquire old plant and showed no interest in the proposal, including an offer in September 1897 to sell works, mains and goodwill etc for £14,000, mains and underground cables then in shipment being included. (134) Early in 1897 the Council sought the guidance of Hesketh as Government Electrical Engineer and in July he presented a lengthy report entitled 'Report on the Electric Lighting of the City of Brisbane, Queensland'. (135) Apart from its relevance to the immediate position the Report gives an excellent picture of the 'state of the art' of electricity supply. His plans for the future were far superior to Barton's — which will be referred to shortly — in terms of prospective station and system efficiency but the capital investment was many times greater than would have been possible for the Brisbane Electric Supply Co. Ltd.

After citing the advantages of electricity over gas, Hesketh gave his reasons why the Council was better fitted to undertake electricity supply than a private company. These were that the Council could borrow money more cheaply and that there were no dividends to pay and on the repayment of the loan the Council had a valuable asset. In brief, 'Electric Lighting is a proper and remunerative undertaking for the Corporation to engage in.'

The suggested procedure was —

> First: That your Council decide whether to undertake an Electricity supply for Municipal and general Electric Lighting and for power purposes, and to what extent. Second: That in the event of a decision in the affirmative, the necessary powers be forthwith obtained, both under the Electric Light and Power Act, and for borrowing the necessary money. Third: That close specifications and plans be prepared and tenders obtained for the scheme as decided on by your Council.

The plant was to be of 400 kW capacity (with an alternative scheme with a capacity of 300 kW), the capital costs being estimated at £44,860 and £32,250 respectively. Details of the equipment for the 400 kW plant are given in Appendix C, showing the system voltage as 440/220 three wire d.c. There were to be four 100 kW high-speed steam-engine driven dynamos and a 440 volt station battery of about 1000 ampere-hours. The battery would 'provide for the proper control and regulation of the supply and also a reserve and enable the steam

plant to be shut down after midnight.' Hesketh's proposals for a tariff structure are too detailed to be given here but basically he considered that this should be on a sliding scale basis so that a consumer using energy for one hour per day should pay as much as 12 pence per kWh and for 12 hours per day 4.6 pence.

Apart from the need to raise finance, an Order in Council was required and by March 1898 this was in hand. However there were many difficulties which delayed gazettal of the Order until July 1899. The Order was designated the 'Brisbane Municipality Electric Light and Power Order, 1899'. The area was the whole of the Municipality, thus including that already covered by the Order granted to the Brisbane Electric Supply Co. Ltd. The Council found the Order unworkable because of the large area to be supplied and sought to have the Order amended.

On 12 June 1900, without having had a reply from the Government, the Works Committee of the Council recommended three steps based on the purchase of energy from the Brisbane Tramways Co. Ltd which had been formed in 1895 and commenced generating electricity in 1897 at a power station in Countess St.

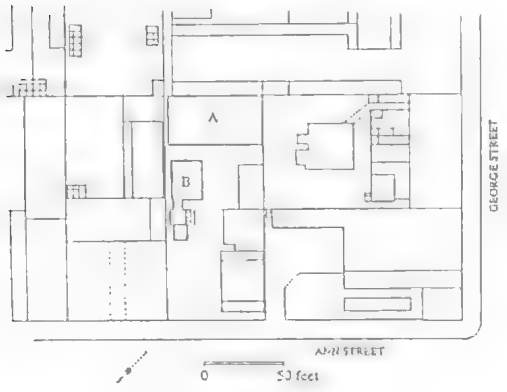


FIG. 43. Brisbane Electric Supply Co. Ltd power station site at 69 Ann St, Brisbane, 1899. The new structures were **A**, a two-storey brick building, 65 ft by 33 ft housing the generating plant etc. and **B**, the boiler shed and chimney. In 1906, a two-storey brick building with full frontage to Ann St was built in front of **A**, and in place of the earlier residence.

FIG. 44. Letterhead showing the Brisbane Electric Supply Co. Ltd Ann St power station c.1900. The temporary boiler house is on the left and stocks of underground cable are shown in the foreground. The sketch is probably by Barton.

> Firstly that the Council should forthwith give the necessary instructions to borrow the sum of £30,000 in order that the necessary plant be obtained to provide the city with electric power and energy, and to receive and distribute the same to a capacity of 400 kW from the Tramways Company within the area set out in the Order in Council as proposed to be amended; secondly that close specifications and plans be at once prepared and tenders obtained for this scheme and as indicated in Mr Hesketh's report; thirdly that an agreement be entered into with the Electric Tramways Company to supply the Corporation with the necessary power, and at a rate of 2½d. per unit delivered at the boundary of the company's works, the agreement to be for five years certain and subject after that time to two years' notice on either side. (97)

At this stage Barton submitted a further proposal to the Council in his own name, as follows —

> Sir, — I have the honour to send you enclosed my tender for the lighting of the city streets, and conditions of taking over the Order in Council from the Municipal Council, in its modified form, reduced area.
>
> I, Edward C. Barton hereby make the following offer with regard to the electric lighting in the City of Brisbane. In consideration of your Council transferring to me the modified Order in Council, with reduced compulsory area, for a period of forty-two years, I am prepared to erect in the main thoroughfare, at my expense twelve

FIG. 45. Brisbane Electric Supply Co. Ltd Ann St power station showing the new building in the middle distance. The ground floor housed the generating plant. The workshops, office and store were on the first floor. The boilers were to the right of the chimney to which iron bands were being fitted at the time because of damage by excessive heat. The premises of Mr Heeschens, a walking stick manufacturer, are in the foreground. Date of photograph, about December 1899.

> are lamps, and to supply current to them at my own expense. Furthermore, I am prepared to supply current to the Council at the foot of their lamp-posts on an all-night and every-night schedule at 2¼d. per unit. Being a local resident, and well-known in this community, I feel that it is unnecessary to produce my credentials for submission to the Council; but as it might affect their consideration of the above offer, I may mention that I have been engaged in the electric lighting industry nineteen years, and was in charge of the lighting of Godalming, the first electrically illuminated town in England. — E.C. Barton, 16 June 1900. (97)

This generous offer was not accepted by the Council and obviously nothing could be finalised without an amended Order. Hesketh's views on the situation are expressed in a letter to the Council extracts from which appeared in the Press on 5 July 1900. The Company referred to is the Brisbane Electric Supply Co. Ltd.

> The reason why the Company can quote a price at which the Council cannot supply their public lighting is simply that they [the Company] rely on the loss on public lighting being made up from their profits on private lighting. The Council cannot supply public lighting at the figure quoted by the Company unless they charge less than cost price, taking the risk of obtaining the balance from the private lighting revenue, as is evidently the intention of the Company. In this connection the bearing which the area of supply has on the cost of generation becomes a very important factor. This is really the point, in my opinion, in which the Company has an advantage over the Corporation. It is still my opinion that electric lighting is a business which should be undertaken by the Council, if it is prepared to give it the same capital, push and business spirit, and it was the impression, conveyed during the last three years of negotiations with the Council on this matter, that such would not be given, which influenced me in thinking that the Council did not intend proceeding with this work, and under such

FIG. 46. Brisbane Electric Supply Co. Ltd Ann St power station site in the early 1900s. This view from Ann St shows the interest taken in the arrival of a Lancashire boiler for installation near the left hand boundary of the site. The boiler was brought in through the premises of Penhaligon Bros, horsebreakers. Mr Heeschens' premises have been moved towards the left hand boundary. Judging from the steam rising from the tanks in the middle distance, the station was already operating.

> circumstances the alternative of some such transfer [of the Order] as is now under consideration is that to which the least objection could be offered. (136)

It is not proposed to give an account of the many subsequent exchanges between the Government, the Council and companies interested in supplying the Municipality. However it should be recorded that about this time the Council took a poll of ratepayers on the question as to whether they should undertake electricity supply. The majority decision was that the Council should get others to do the work on their behalf. (88) This had followed a clear indication that the request for an amendment to reduce the area of supply would be refused by the Government unless the Council carried out the work themselves. Months of argument with proposals and counter proposals followed as each scheme lapsed. This was to be the pattern for the Council's attempt at municipalisation of electricity supply in Brisbane for many years after Barton's retirement from an active part in the industry.

THE ANN ST POWER STATION: While increasing the area of supply through additional Orders in Council was important to Barton and his associates in the late 1890s, the provision of adequate generating capacity to meet the growth in demand would also have been of continuing concern. Not surprisingly the small area allocated to generating plant in the building at Edison Lane — estimated at a total of 1000 sq. ft at ground floor and basement levels — had proved inadequate after ten years.

Few chronological records of the installation of plant have been found for the first decade of electricity supply by the Company apart from the installation of the first dynamo used to supply the G.P.O. in 1888. As already stated this was almost certainly added to in the same year with a 24 kW unit. Thereafter the timing of the additions is not known although Barton's notes refer to an addition in 1891. (137)

In reporting to the Government, Barton gave the plant capacity as 60 kW on 1 September 1896 and noted that an addition of 18 kW was made in October of that year. So the higher value of 90 kW given by Hesketh in an address delivered in May 1898 was seemingly fairly correct having in mind Barton's proposed expansion. (138) It is interesting to note

Hesketh's further comment that 'Brisbane has a plant that has bravely struggled through bad times, and hopes with reason, to reap a fair benefit under now existing legislation'.

A prediction of the next steps in the development of the electricity supply system has been found in a letter by Barton dated 22 November 1897. He gave the estimated costs for an increase of capacity from 'our present plant of 45 kW' to 125 kW and later to 300 kW together with the net annual revenue in the three cases as £721, £2250 and £6050 respectively. The value of 45 kW is difficult to reconcile with his own earlier statements; he may have had some reservations about the reliability of some of the plant. (130) He explained his plans for a move to a new site that would accommodate plant of much increased capacity as follows —

> I have laid out the plans to include a smoke-stack fit for a 300 kW plant and the underground cables in the main streets for distributing such an output but the other plant in the Central Station will be in the first instance two 50 kW units (boilers, engines and dynamos) and feeder cables from the Central Station to the street mains will be capable of distributing current from the two generators. As the requirements grow, the plant and feeders can be enlarged without interfering with the continuous operation of the plant and without waste in alterations. The chimney stack and the street mains will remain unaltered.

After further reference to the expected gains in economy of operation he points out that a further benefit will arise from the fact that —

> we shall be able to burn coal alone as a fuel with the new plant, whereas now, owing to the low chimneys [at Edison Lane] and the fear of an injunction for a smoke nuisance, we have to use 3 tons of wood to one of coal — and the wood fuel is dearer than coal. (107)

FIG. 47. Brisbane Electric Supply Co. Ltd Ann St power station. The first installation in 1899 was a slow speed horizontal steam engine driving two dynamos probably 110 V. d.c. and rated at about 24 kW. The Crompton type dynamo on the right was probably manufactured by the Company. Shortly afterwards there was added a Robey high-speed steam engine direct coupled to an Elwell-Parker dynamo of 50 kW capacity, shown on the right.

TABLE 1. Generating Plant at the Ann St Power Station, 1899 to 1911.
(all direct current)

Estimated Year of Installation	Item
1899	1—single cylinder horizontal steam engine, 2 ft 6 in. bore, make unknown, belt driving two Crompton type dynamos each about 24 kW, probably 110 V.
1900	1—Robey vertical steam engine direct coupled to an Elwell-Parker 220V., 250 A. dynamo.
1901	1—Brush (Raworth) vertical steam engine (F size, Universal) direct coupled to an Elwell-Parker dynamo, as above.
1901	1—Parsons steam turbine, 50 kW, direct coupled to a 240 V. dynamo. (£955)
1902	1—Parsons steam turbine, 75 kW, direct coupled to a 220 V.dynamo. (£1223)
1902	1—Parsons steam turbine, 150 kW, direct coupled to two 110 V. dynamos in tandem.
1906	1—Parsons steam turbine, 200 kW, direct coupled to a dynamo. (£1646)
1907	1—Parsons steam turbine, 200 kW, direct coupled to a dynamo. (£2000)
1909	1—Parsons steam turbine, 700 kW, direct coupled to two 400 kW, 240 V. dynamos in tandem. (£4405)

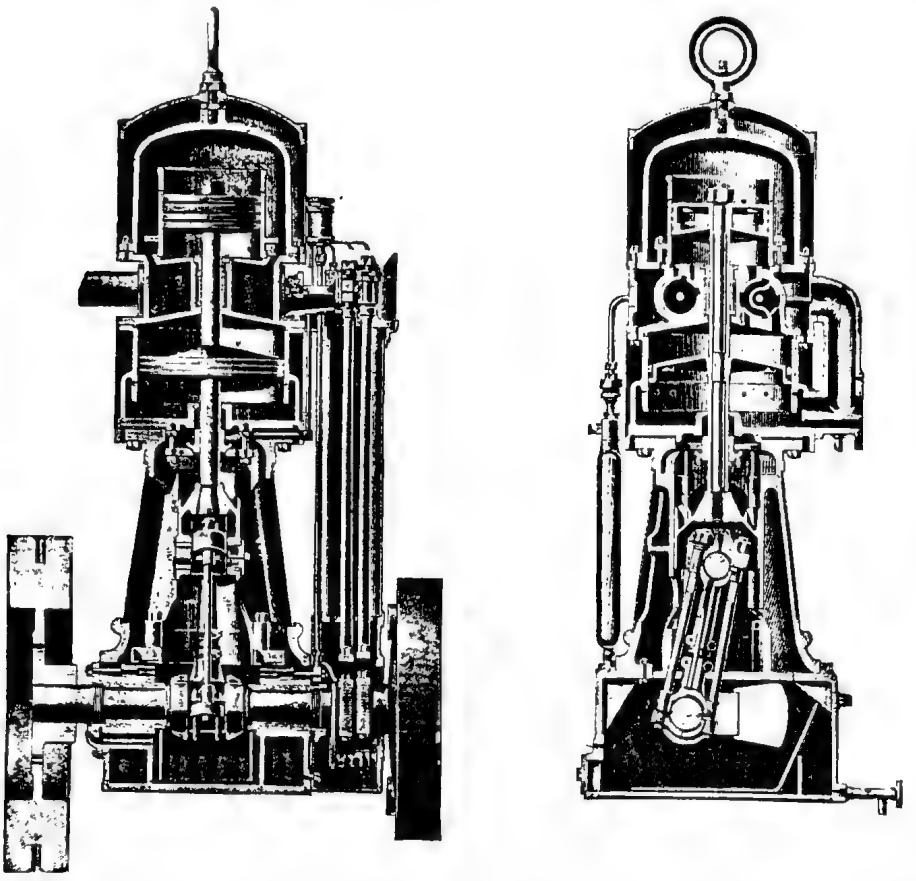


FIG. 48. Longitudinal and transverse sections of a Brush (Raworth) 'Universal' high-speed steam engine. This was installed in the Brisbane Electric Supply Co. Ltd Ann St power station in 1901 and was one of the two high-speed steam engines later displaced by steam turbines. The Brush engine was direct-coupled to an Elwell-Parker 50 kW dynamo. It was approximately 5 ft high and the engine-dynamo combination required far less floor space than the earlier slow-speed installations.

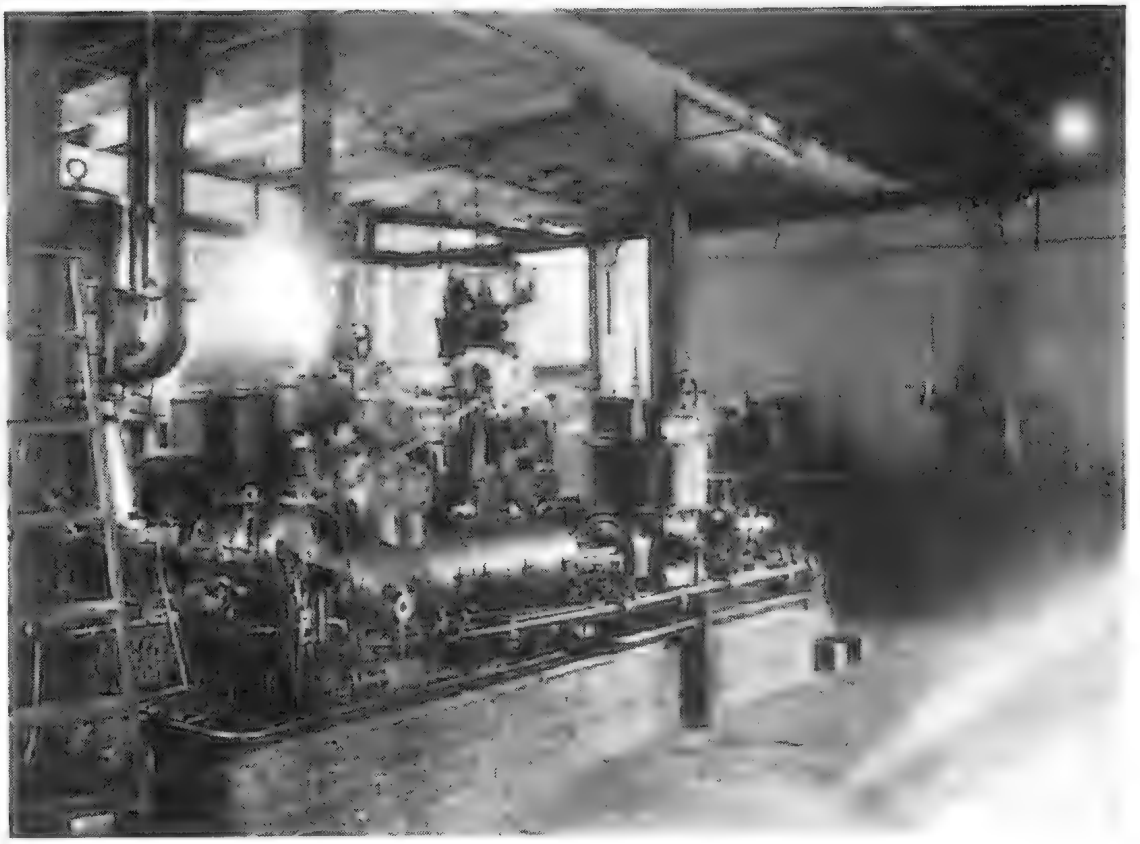


FIG. 49. Brisbane Electric Supply Co. Ltd Ann St power station. Parsons steam turbo-dynamos are shown in the foreground and background and are believed to be the first and second sets installed in 1901 and 1902 respectively. The first was rated 50 kW and the second, 75 kW but were not identified in the original photograph. A Brush (Raworth) high speed steam engine driving an Elwell-Parker dynamo of 50 kW is on the extreme left.

The firm had been warned in January 1897 by the Department of Post and Telegraph about the smoke and soot nuisance.

The newly-leased site was at the rear of existing buildings at 69 Ann St, Brisbane and Barton planned the two storey building in detail. Surprisingly there were no features, apart from the tall chimney, which distinguished it from a general purpose factory building. In particular there appeared to be no provision for an overhead crane, no doubt because of the cost. However, compared with the conditions under which employees worked at Edison Lane, the building which was erected in 1899 was a vast improvement. From Barton's estimates the ground and first floors each had an area of about 65 ft by 33 ft and he showed the chimney height as 105 ft, which must have made it quite a landmark. A contemporary site plan (Fig. 43) shows the general arrangement and this is further clarified by Barton's sketch, apparently intended to be printed on the firm's notepaper. (Fig. 44) At this stage the boilers appear to have been housed in an open shed. An overall view of the site is shown in Fig. 45.

Plant was installed during 1899 and the arrival of one of the boilers is shown in Fig. 46. According to G. Mackenzie the first boiler was made by Sutton and Co., Kangaroo Point, Brisbane, later Evans, Anderson and Phelan. (80) F.R. L'Estrange gave the working steam pressure as 110 lb. per sq. in.; a later photograph shows at least four boilers of the Lancashire type and that they were hand fired with coal. He also remarked that the 'steam from the [non-condensing] power plant exhausted into a huge array of galvanised iron tanks from which visitors to the firm's offices received a steam bath on their way upstairs.' (18) This must have been before 1906 when the

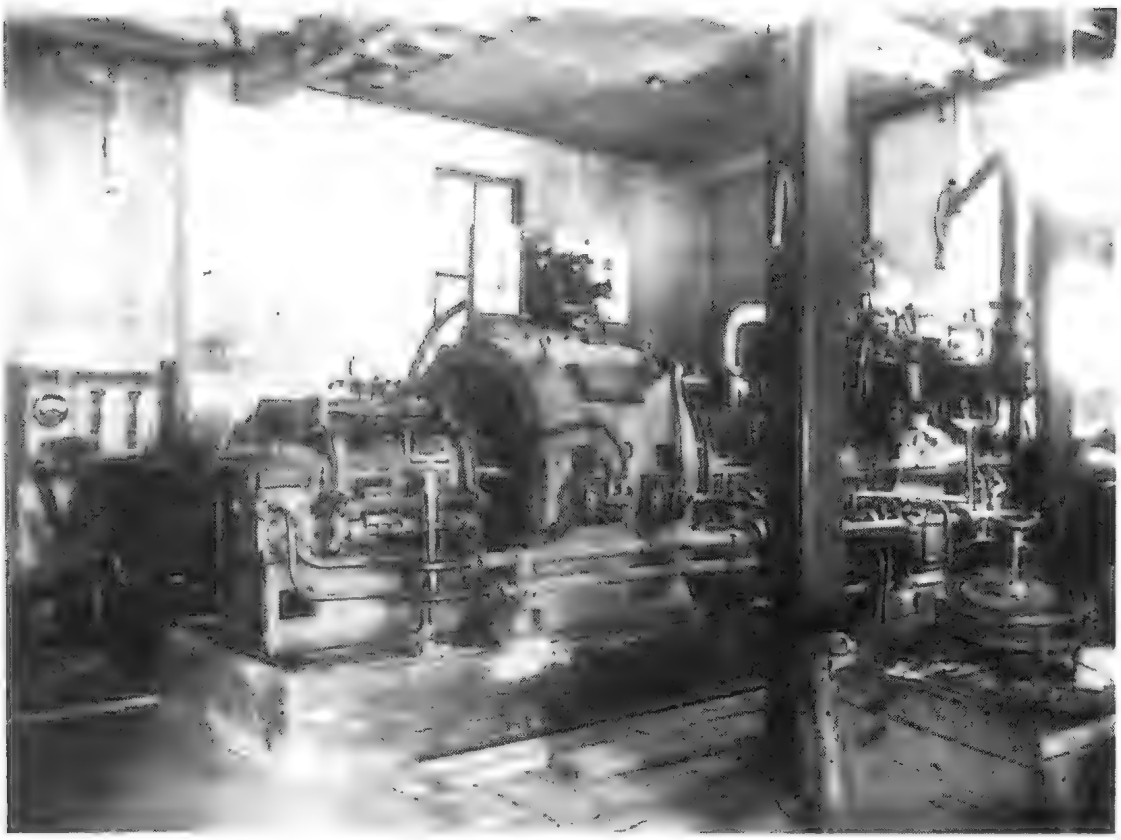


FIG. 50. City Electric Light Co. Ltd Ann St power station. One of the two Parsons 200 kW steam turbo-dynamo sets installed in 1906 and 1907. The earlier arrangement of external magnetic poles and field windings was now replaced by a cylindrical stator and internal field windings. Photograph published in May 1909.

next new building was erected.

By now the Company was supplying electricity for 122 hours per week and, with the increasing demand, plans for installing additional plant were in hand. The generators installed in the first year or two were driven by reciprocating steam engines (Figs 47,48) but even in 1899 Barton was considering a 50 kW steam turbo-dynamo set. This was ordered from Messrs C.A. Parsons and Co. Ltd, England in 1901 and installed in the same year. Barton may well have been influenced by the experience of the Victorian Railways Department. According to an account published in 1909, the Department installed 200 kW Parsons steam turbines in 1899 'then in their early struggling period.' The account stated that —

> this was the first instance of the use of steam turbines in the Southern Hemisphere. It was predicted on every side that turbines would be a complete failure but the step taken is fully justified by time and results. The turbines were a thorough success. (43)

This was evidently Barton's experience too as five more Parsons turbine sets followed over the next several years (Table 1). Unfortunately there are inconsistencies in the early records and those of the manufacturer are incomplete. In particular, in some cases the rated d.c. voltage can only be guessed. Small differences such as between 110 V. and 115 V. and between 220 V. and 240 V. are not of practical significance.

Capacity of the station increased rapidly over the decade (Table 1, Appendix D). By 1909 the installation of turbine driven plant was complete and totalled about 1400 kW compared with the 300 kW capacity envisaged by Barton. Some, if not all, of the reciprocating steam engine driven plant had been retired at this stage.

Illustrations of some items of plant at the Ann St site have been preserved (Figs 49-52). No general plan is available although two or

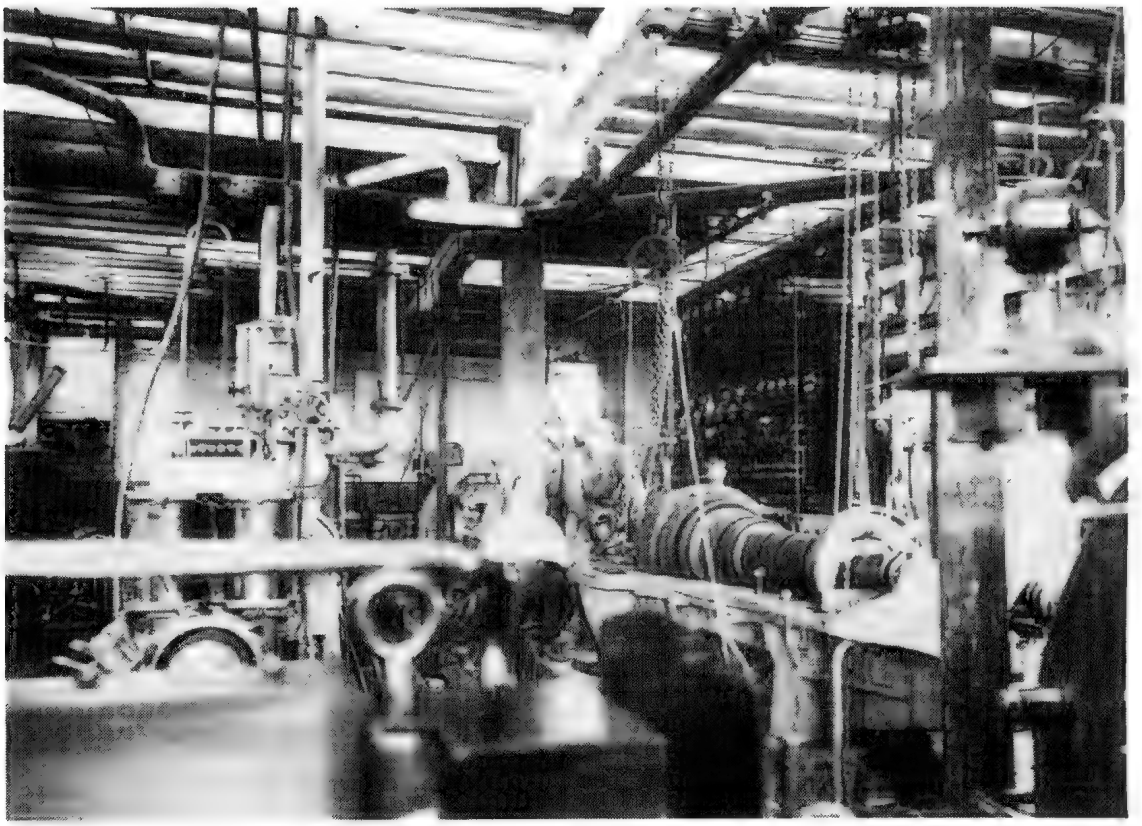


FIG. 51. City Electric Light Co. Ltd Ann St power station. In 1909 a 700kW steam turbo-dynamo set with tandem dynamos each of 400 kW capacity (on the right) was the largest set installed at the station. The main electrical switchboard is in the background. The central figure, seated, is Alfred Ward, a Director and Power Station Engineer.

three generating units can be seen in some of the photographs showing that space was restricted. To show the construction of the first turbine installed at the site, one of similar capacity, although differing in having a condenser, is shown in Fig. 53. The main electrical switchboard is shown in Fig. 51 and Fig. 52. Mackenzie recalled that this was constructed in the Edison Lane workshops. The panels were of marble and had brass busbars bolted to the front and back. His explanation of the busbar arrangements is not clear but

TABLE 2. Orders in Council issued to the Brisbane Electric Supply Co. Ltd and the City Electric Light Co. Ltd — 1897 to 1917.

Name of Original Electric Authority	Date Order Gazetted	Remarks
Brisbane Electric Supply Co., Ltd	9-6-1897	City
Ditto	13-5-1903	George street East
Ditto	30-12-1903	George street West
Ditto	28-4-1904	Balance City Area
City Electric Light Co., Ltd	3-4-1908	Valley
Ditto	10-8-1916	South Brisbane
Ditto	5-7-1917	Balance North Brisbane

FIG. 52. City Electric Light Co. Ltd Ann St power station. A 700 kW steam turbo-dynamo is on the left and the main electrical switchboard with the underground distribution cables on the right. An earlier steam turbo-dynamo is on the extreme left.

evidently the front ones were the station busbars and the back ones were for individual dynamo or distribution feeder circuits. To select one of the latter for connection to the station busbars, two threaded copper rods were passed through clearance holes in the front busbars and engaged with corresponding threaded holes in the back busbars. A shoulder on each rod completed the contact between the busbars. Switching was by means of double pole knife switches with fuse protection. (80)

The three-wire system giving supply at 110 V. for lamps and 220 V. for motors was continued at the Ann St station, one requirement being a balancer set of 7.5 kW. (18,139)

General electrical contract work continued in addition to the maintenance of power station and distribution equipment. The layout of the workshops has not been found but a corner is shown in Fig. 54 where an armature is being rewound and some of the workshop machinery is seen in the background. A storeroom believed to have been at the Ann St site is shown in Fig. 55.

Staff numbers increased from about 30 in 1899 to over 60 by 1911. The group photograph (Fig. 56) was taken in the new boiler house at Ann St in 1906 or later. From the early days there were annual picnics and a photograph of the Directors and the Picnic Committee taken c.1908 is shown in Fig. 57. The Committee was no doubt chaired by Barton as Managing Director with the support of his fellow Directors and senior staff.

Once the initial generating plant and the Company's workshops were established at Ann St there would have been no need to continue the lease of the Edison Lane building. The year 1900, suggested by a plan by F.R. L'Estrange, seems likely to be correct as that in which the old generating plant was retired. (18)

FURTHER ORDERS IN COUNCIL: W.M.E. L'Estrange continued the story of the Orders in

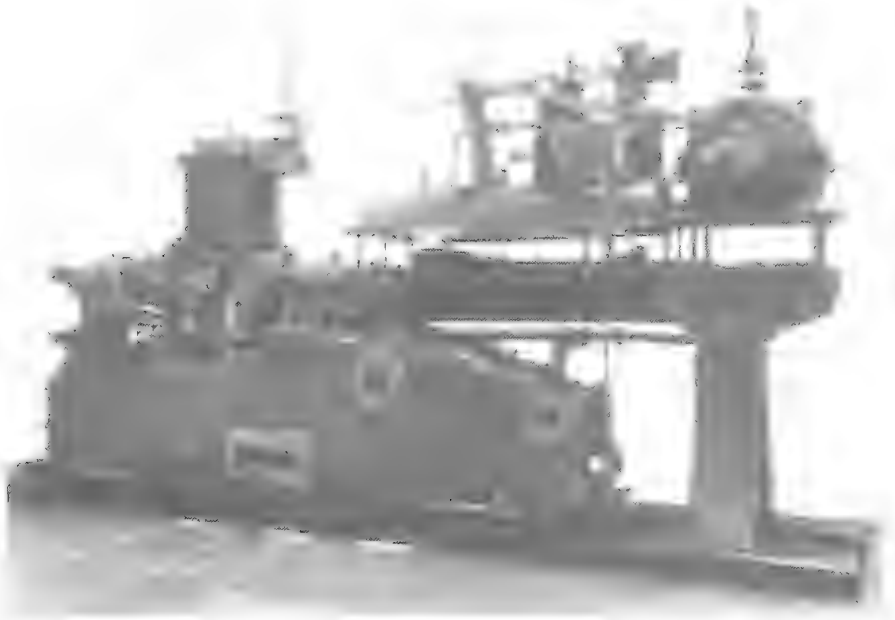


FIG. 53. A 60 kW Parsons steam turbo-dynamo supplied to the National Physical Laboratory, England in 1901. The Brisbane Electric Supply Co. Ltd installed a 50 kW Parsons set in 1901 at Ann St and this is likely to have been generally similar to the 60 kW set. Both turbines operated at a steam pressure of 110 lb. per sq. in. but the 50 kW set was non-condensing. The upper part of the turbine casing has been raised to show the blading, the maximum diameter being 9½ in. The overall length of the set is c.18 ft.

FIG. 54. City Electric Light Co. Ltd Ann St power station building. The upper floor housed the workshops which contained at least three lathes and a drilling machine. Overhead shafting and belt drives to each machine were normal. Two apprentices in the foreground are winding a 'Gramme Ring' armature.

FIG. 55. Part of a storeroom believed to have been on the upper floor of the Ann St power station building of the Brisbane Electric Supply Co. Ltd or its successor, the City Electric Light Co. Ltd. On the top shelves are LeClanché batteries; on the lower shelves to the right, carbon rods for arc lights. Immediately above bench level are small motors of a type made by Barton and White and at bench level are electric fans and other small motors. A variety of porcelain insulators is stored in the lower bins and an arc light is standing on the floor on the left.

FIG. 56. Staff of the City Electric Light Co. Ltd, c.1906. The central figure (standing) is Edward Barton, General Manager. The staff numbered about 30. Standing, Back (left to right): J. Pointon, J. Adamson, G. Lockyer, G. Pointon, W.G. Hamilton Snr., W. Davis, C. Switzer, — Robinson. Standing, Forward (left to right): Mr. A. Ward, A. Thompson, V. McLeod, J. Connolly, J. Whiteford, E. Cripps, E. Waddington, J. Sanker, Mr. E.C. Barton, E. Carpenter, Mr. W.J. Young, Mr. J. Ryan, H. Carpenter, D. Morris, F. L'Estrange, W. Dyne, H. Hedger. Sitting (left to right): G. Mackenzie, S. Hughes, H. Moles, H. Turk, G. Lightbody, V. McNiven, A. McCall, N. Loftus, F. Bagley, W. Wright. Sitting (in front): G. Milne, F. Roberts. G. Brian, W. Hamilton, Jnr.

Council thus —

> In 1902 the City Council [again] opened negotiations with the Brisbane Electric Supply Company for the purchase of its assets. During the same year the Council tried to 'farm out' the dead Order [of 1899] to the Tramways Company, Messrs Wright and Reason, and the Brisbane Electric Supply Co. Ltd in turn, while an attempt was also made to take up a small area of supply. In 1903, the Company obtained two additional Orders in Council; one for the Public Library area [George St East] and the second for the area known as George St West, both Orders being for a minimum period of 42 years but the Council forced the Company into an agreement giving the Council an option to purchase under certain terms. The Council notified the Company of its intention to exercise the option of purchase but did not do so. In this year also, the Company applied for an Order in Council for the Valley area but at the same time a Company not then registered, but later to be known as the Fortitude Valley Electric Light and Power Company, applied for an Order also for the Valley area which application was opposed by both the Brisbane City Council and the Brisbane Electric Supply Co. Ltd. In 1904 the latter's application for an Order for the Valley was refused but an Order for the area was granted for a minimum period of 42 years to the Fortitude Valley Electric Light and Power Co. Ltd. (55)

Also in 1904 the Company applied successfully for an Order which consolidated the three earlier Orders for parts of the City area (Table 2). In spite of the continuing obstructions to the extension of the area of supply the revenue of the Company showed a steady increase from its inception. (Fig. 58) Power station operating hours had been 8 am to midnight then 5.30 am to 11.30 pm and about 1904 they were extended to provide a continuous service.

A NEW NAME — THE CITY ELECTRIC LIGHT CO. LTD: As part of a plan to attract more capital, the Brisbane Electric Supply Co. Ltd decided to reform with the new name — City Electric Light Co. Ltd. Although the name sounds

FIG. 57. City Electric Light Co. Ltd Directors and Annual Picnic Committee, c.1908. Seated (l. to r.): J.Ryan (in charge of Office); W.M.E.L'Estrange (Secretary and Director); E.G.C.Barton (General Manager and Director, also Patron of the Committee); W.J.Young (Works Manager and Director); A.Ward (Chief Engineer and Director); R.A.L'Estrange (Publicity Officer). Standing (l. to r.): J.Hornsby (Storekeeper); W.Burnett (Shift Electrical Engineer); V.A.McLeod (Chief Clerk).

restrictive the Memorandum of Association sets out the 25 objects of the Company which provide for every possible development and for operating in any locality. Even the right to erect telephone systems is included. (140) Edward Barton and W.J. Young were the liquidators of the old Company and the new Company was formed of these two together with six other members of the old Company, and three new members. The new Company paid £20,000 to the old Company and, according to G.G. L'Estrange this was distributed to the old Company's shareholders as shares or cash. (71)

The City Electric Light Co. Ltd was registered in Brisbane on 2 December 1904 with a capital of £100,000 divided into 100,000 shares of £1 each; of these 60,000 were to be taken as fully paid and issued to the liquidators or their nominees. The first statutory meeting of the new Company was held on 31 March 1905 and the Chairman (E.J. Holmes) reported thus —

> The Company has no history [sic] and therefore in a literal sense there is nothing to report to the shareholders beyond the fact that the Orders in Council, plant and goodwill of the Brisbane Electric Supply Company have been successfully transferred to this Company. The Directors are well pleased to give this information as the transfer of Orders in Council are rare and are apt to lead to protracted negotiations owing to lack of precedent ... (141)

On completion of the transfer, Barton and his wife Mary had a total of 12,444 preference shares and 6222 ordinary shares. Appropriately Barton was given six months' leave of absence on full pay and in April he and his wife left for a European visit — his first since his early experiences there in the 1870's and 1880's. On his return in October, his salary was increased to £420 p.a.

In 1905, the Order in Council for Fortitude Valley was forfeited by the Fortitude Valley Electric Light and Power Co. Ltd and the City Electric Light Co. Ltd applied for the same area. The Government offered an Order for a period of 14 years only and the Company refused to accept this. After further negotiation the Government increased its offer to 21 years and, when this was refused by the Company, to 32 years which the Company finally accepted (Table 2).

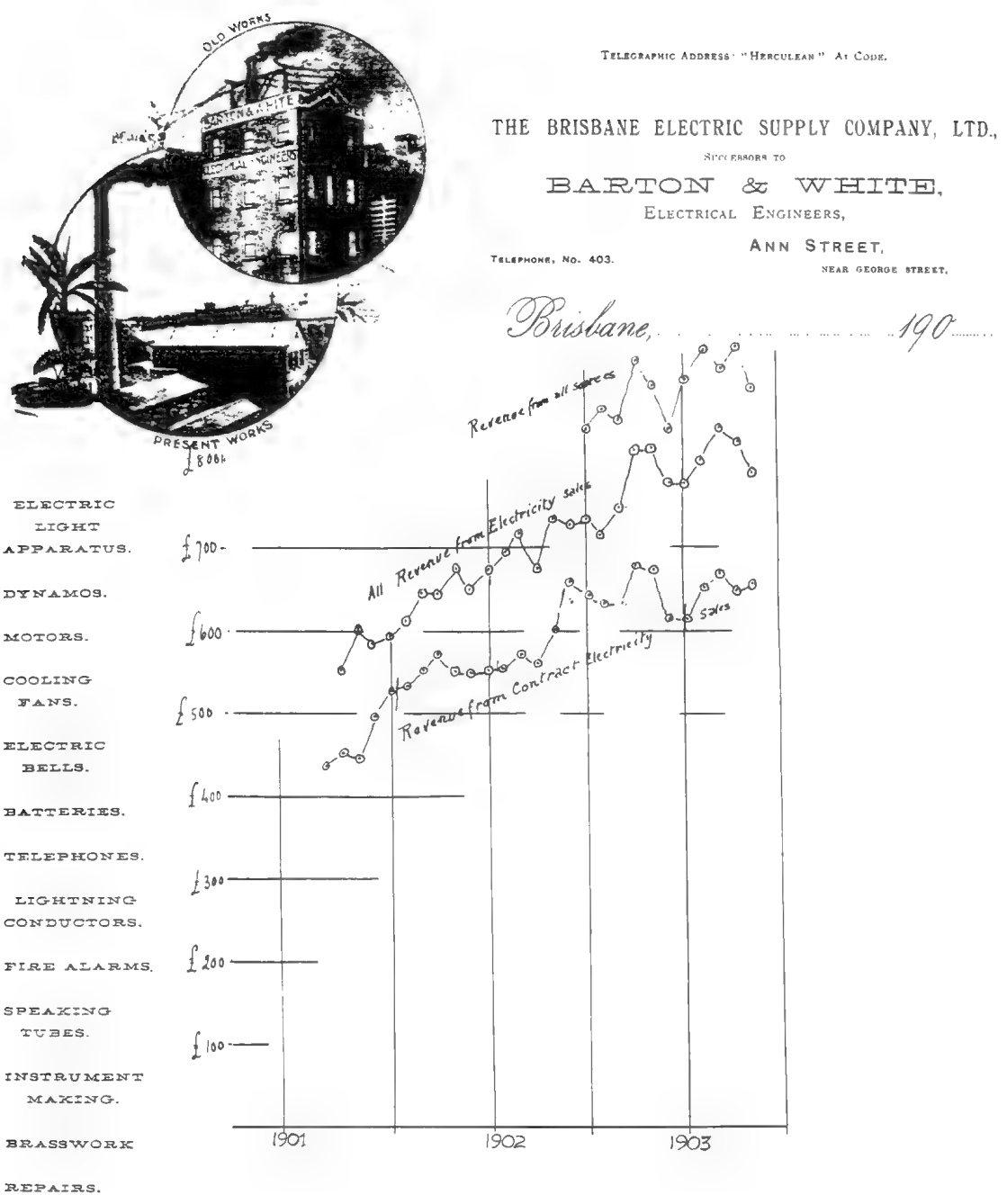


FIG. 58. Brisbane Electric Supply Co. Ltd. Graphs of monthly revenue from February 1901 to May 1903, drawn by Barton. (68) There was a rapid rise in electricity sales over this period compared with a few years earlier.

BRISBANE AREA, 1906 TO THE EARLY 1920'S

IMPROVEMENTS AT ANN ST AND PLANS FOR THE NEXT POWER STATION: In 1906, the area leased for the Ann St power station was increased and a new building was erected in front of the existing building. (Fig. 59) This provided offices, store area and workshops which were

FIG. 59. City Electric Light Co. Ltd building in Ann St, c.1906 or later. The boilers, coal stocks and underground cable drums occupied the ground floor. The pairs of windows of the Ann St facade, reading from left to right, were those of the main store, the Board Room and the Office. Under the painted sign on the right, reading from left to right, were the windows of the Office, second store and workshops.

previously on the upper floor — above the engine room. The effective headroom of this room was raised from 16 to 28 ft apparently by removing the flooring 'giving thereby ventilation and comfort to the staff as well as increasing the output of the dynamos.' (142) The dimensions of the new two storey building are given as 115 ft by 22 ft; the latter figure is evidently an error for 62 ft — the frontage to Ann St. It is clear that the boilers were accommodated on the ground floor of this building adjacent to the existing chimney (Fig. 60). No additional floor space was provided for the generating plant; eventually six turbo-dynamos and ancillary equipment were housed in approximately 2000 sq. ft.

This was a period of rapid growth in demand for electricity supply, attributable to the realisation that electric motors had advantages over steam and internal combustion engines, coupled with a reducing charge for energy. As an example of the increase in demand the connected motor load increased from 79 h.p. in 1904 to 254 h.p. in 1905; the corresponding total system loads were 361 kW and 601 kW. (68) A few years later the drawn-wire filament lamp was produced commercially and the efficiency was much higher than that of the carbon filament type; consequently the demand for electric light increased markedly.

Barton was anxious to attract capital to enable the Company to develop and meet these expected demands. Among other approaches he was in touch with Messrs Crompton and Co. Ltd, London and, in a letter dated 8 March 1907, he summarised the position in Brisbane thus —

> Our present station is situated in a central position 300 yards from the centre of the town and we run non-condensing. The expenditure for cartage of coal and removal of ashes amounts to a considerable sum during the year. Removal to a waterside station, with condensation and water carriage of coal and ashes, would effect a saving of over £1000 per annum. We are laying our plan for a station of 3000 kW. We would then install about 500 kW of boilers and electrical generating plant to carry the load until the present 750 kW plant was removed to the new site. We recognise that we will have to push vigorously for business in order to justify the proposed ultimate 3000 kW plant but we believe that the outlet exists and can be obtained easily enough ... [We] will communicate again when our plans mature. (143)

No one could have foreseen the tremendous increase in demand for electricity in the following years. Indeed by 1923 the installed capacity exceeded several times Barton's 'ultimate' capacity for the station.

In 1908 a site at the corner of William and Margaret Streets, earlier occupied by Pettigrew's Saw Mills, was selected for development as a power station. It had the advantages of proximity to the Brisbane River as envisaged by Barton and thus the first of the Directors' Reports for 1909 described the proposed development as the 'Waterside Power Station.' W.M.E. L'Estrange recalled that after the City Electric Light Co. Ltd purchased the site in 1908 it was —

> served with a notice of land resumption by the Government but the resumption was not proceeded with in view of the strong representations made by the Company on its own behalf. (55)

Before describing the development of the site, the vital matter of acquiring further Orders in Council to ensure increasing demand should

Fig. 60. City Electric Light Co. Ltd Ann St power station. There were at least four Lancashire type boilers working at a steam pressure of 110 lb. per sq. in. They were hand fired with coal which was delivered in single horse drays from Roma St Railway Station and dumped alongside the boilers. In the left background, part of the flooring of the upper storey was omitted to improve ventilation of the boiler house. Photograph published in May 1909.

be appreciated. This was reviewed by L'Estrange as follows —

> In the following year [1909] application for Orders in Council was made for the balance of the North and South Brisbane areas. The Company at that time held franchises covering an area of half a square mile, and the Brisbane Gas Company had obtained an area of eighty square miles. The Orders applied for would have brought the Company's area up to five square miles but it is interesting to note that the Melbourne Electric Supply had 78 square miles, and the Adelaide Electric Supply Co. Ltd, 155 square miles within their respective areas. In respect to the application for the North Brisbane Order, the Government offered the Company an Order with a minimum period of ten years, and the Company asked, in very strong terms, the reason for such unjust and differential treatment.
>
> In 1911 the Municipality of South Brisbane applied for an Order, which application was opposed by the Company, but no finality was reached in respect to the Orders applied for until in 1916 an Order in Council for the South Brisbane area was granted for a period of 10 years, and in the following year an Order in Council for the balance of the North Brisbane area for 10 years was granted to the Company. (55)

Detailed planning of the new power station would certainly have involved Barton and this may have been a factor in his resigning as Managing Director in June 1909 and taking up the position of Consultant to the Company at a salary of £300 p.a. — £175 less than his previous salary. This did not exclude private practice as an advertisement in the Press showed. The announcement read —

> He is now at liberty to engage in private practice as a Consultant and invites correspondence on all matters connected with electric lighting, power etc. (144)

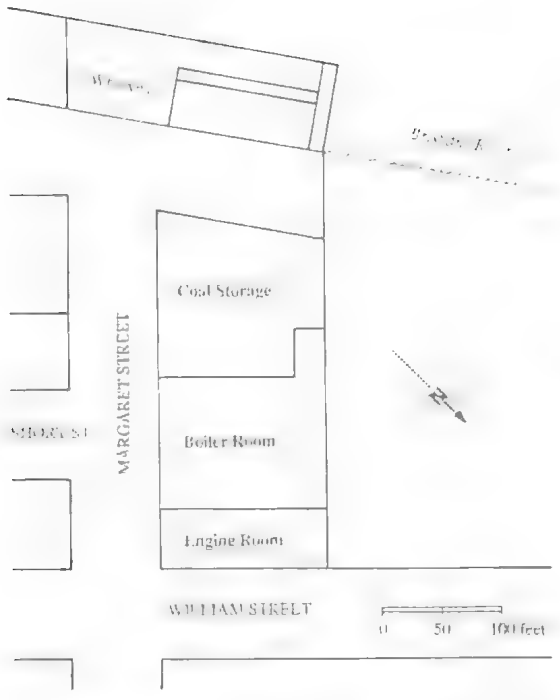


FIG. 61. City Electric Light Co. Ltd William St power station. This general layout plan shows the intended development of the site acquired in 1908. It had the great advantage of close proximity to the Brisbane River; in addition, capital was available to erect an adequate building. The site was earlier occupied by Pettigrew's Queensland Steam Sawmills.

In June 1910 he described himself as 'Electrical Adviser to the City Electric Light Co. Ltd and the Brisbane Board of Waterworks.' (145) Shortly afterwards the Company increased his fee to £425 p.a. in addition to his fee of £50 p.a. as a Director. There was no top level appointment as an obvious replacement for Barton so it has been concluded that he and his close associates, L'Estrange, Ward and Young — all being paid annual fees of about £500 — made the major technical decisions until March 1913 when W.H. Vincent, MIEE was appointed Chief Electrical Engineer at a salary of £600 p.a.

The new station presented a challenge and an opportunity to include features that would greatly improve the efficiency of operation — in particular, to take full advantage of the proximity of a large river. No plans have been found for the structure or initial layout of plant in the power station but it has been possible to sketch a general plan of the site (Fig. 61) based mainly on drawings dated September 1913 which were prepared to show final developments of the engine room and boiler house. For convenience these will be referred to as Vincent's plans. (Figs 62,63) (146)

Erection of the building commenced in 1910. The only contemporary photographs show a fire-tube type boiler in transit from South Brisbane (Fig. 64) and the building of flues and other features of the boiler house (Fig. 65). The finished appearance of the elevation fronting William St is shown in Fig. 66.

OPERATION AND DEVELOPMENT OF THE WILLIAM ST POWER STATION: The first operation of the station was expected 'during the next few months' from the end of January 1911, the first steam turbo-dynamo set having been ordered from Parsons through Messrs William Adams and Co., Brisbane in 1910. The rating was 700 kW and it was operating in July 1911. A 500 kW turbo-dynamo set with two dynamos in tandem was ordered from the Electric Construction Co., England in August 1910. (147) This was also operating in 1911, and the 700 kW Parsons turbo-dynamo installed in Ann St in 1909 was probably transferred in the same year bringing the total capacity at William St to 1900 kW, and the combined capacity of the dynamos at the two stations to over 2500 kW. During the period 1912 to 1913, most if

FIG. 62. City Electric Light Co. Ltd William St power station. The only record of the layout of the boiler house and engine room is a *proposed* rearrangement dated September 1913. The upper part shows an intended provision of ten two-drum water-tube boilers fired by chain grate stokers, in place of the original fire-tube boilers. The lower part shows the intended layout of the generating plant and switchboards in the engine room. The turbo-alternator sets installed in 1913 and 1914 (A and E) and the intended future 2000 kW, sets (C) are shown but the turbo-dynamos, including those transferred from the Ann St power station were omitted. None of the 2000 kW sets was ordered, the first additional plant being a 5000 kW, 5000 V. turbo-alternator installed in 1919. **A**, 500 kW turbo-alternator. **B**, 500 kW rotary convertor. **C**, 2000 kW turbo-alternator. **D**, 1000 kW motor convertor. **E**, 1000 kW turbo-alternator. **F**, 1000 kW rotary convertor. **G,H,I**, electrical switchboards for d.c. distribution, station supplies, high tension a.c. respectively.

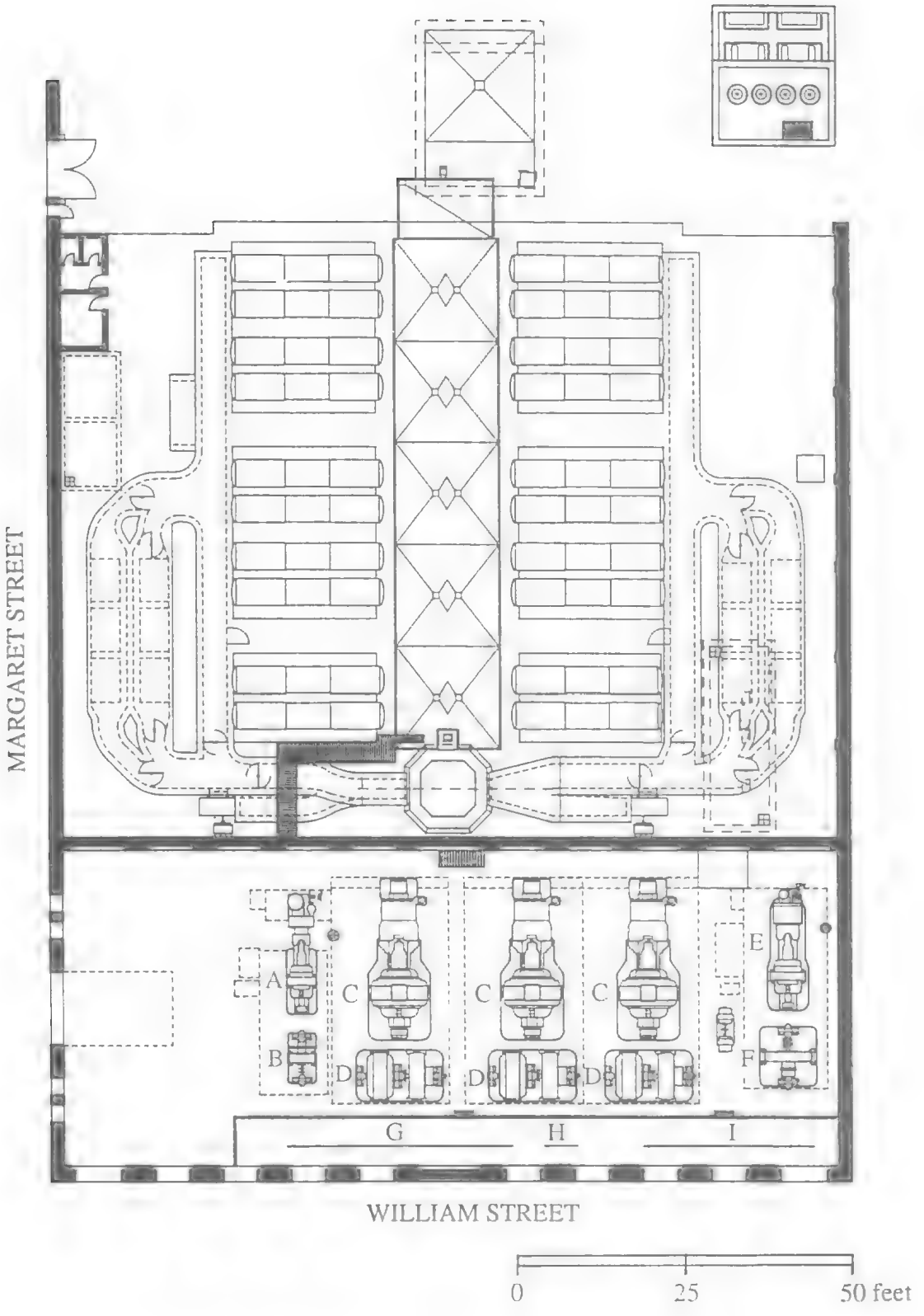

MARGARET STREET
A
B
C
C
C
D
D
D
E
F
G
H
I
WILLIAM STREET
0
25
50 feet

TABLE 3. Generating Plant at the William St Power Station, 1911 to 1923.
(direct and alternating current)

Estimated Year of Installation	Item
1911	2—Parsons steam turbines, 700 kW, direct coupled to two 400 kW, 240 V. dynamos in tandem. One set ex Ann St station. (Second set, £4295)
1911	1—Willans and Robinson steam turbine, 500 kW, direct coupled to two E.C.C. 250 kW, 240 V. dynamos in tandem. The dynamos were replaced in 1913 by a Siemens six phase, 500kW, 50 Hz alternator connected to a 500 kW rotary convertor.
1912—13	1—50 kW, 1—75 kW, 2—200 kW turbine sets (Table 1) transferred from Ann St station to the William St station.
1914	1—Willans and Robinson steam turbine, 1000 kW, direct coupled to a Siemens six phase, 50 Hz alternator connected to a 1000 kW rotary convertor.
1917	1—Ferranti high speed reciprocating steam engine, 600 kW, cross compounded, direct coupled to a Dick, Kerr three phase, 50 Hz alternator.*
1919	1—British Thomson Houston steam turbine-alternator set, 5000 kW, three phase, 50 Hz, 5000 V.
1920	1—General Electric (USA) steam turbine-alternator set, 5000 kW, three phase, 50 Hz, 5000 V.
1923	1—Metropolitan Vickers steam turbine-alternator set, 12,500 kW, three phase, 50 Hz, 5000 V.

*installed and tested but said to be never used

Note: Turbines installed at Ann St were supplied 'non-condensing' and converted to 'condensing' when installed at William St.

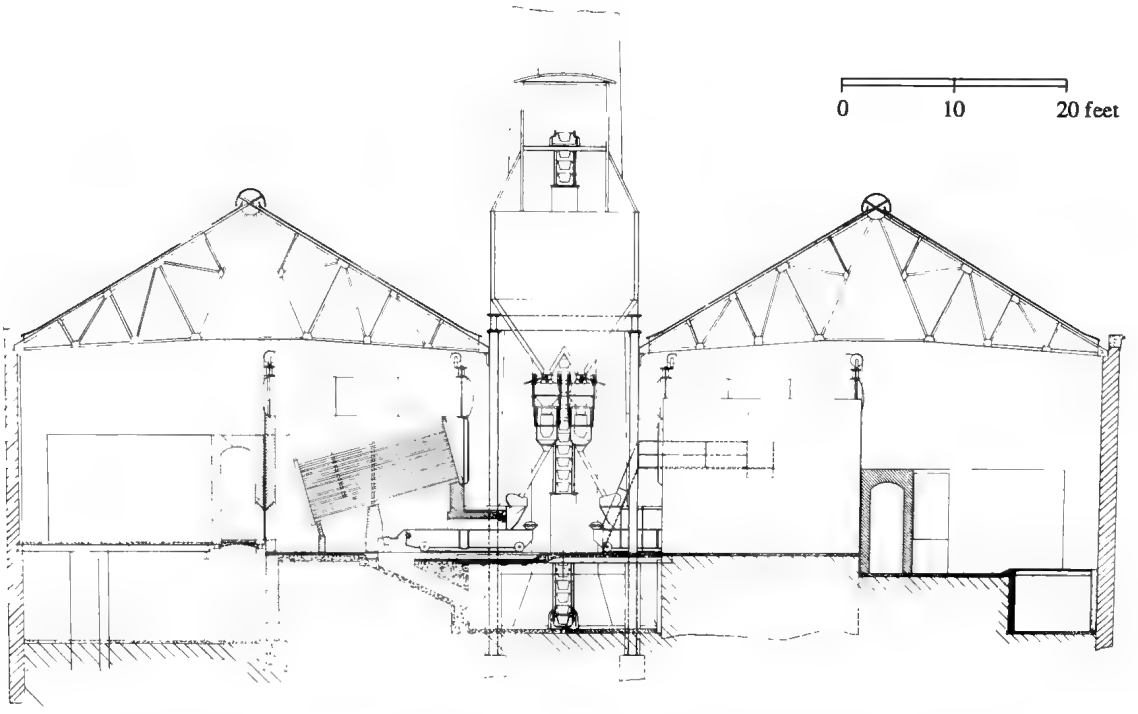


FIG. 63. City Electric Light Co. Ltd William St power station. The boiler house was rearranged in 1913 to accommodate water-tube boilers in place of the fire-tube boilers originally installed. The greater headroom needed required the boiler house roof to be raised by seven ft. In addition new flues, coal bunkers, conveyors and, later, extra chimneys were provided.

FIG. 64. City Electric Light Co. Ltd William St power station. A boiler manufactured by Daniell, Adamson and Co. Dunkinfield, England is shown in transit from the South Brisbane wharves to the station, seen in the background. The 22 h.p. traction engine took 12 hours for the journey. The *Queenslander* described the event in September 1910 as 'an adventurous business and the task was only accomplished after many trials and troubles involving considerable traffic delay and no little anxiety.'

FIG. 65. City Electric Light Co. Ltd William St power station. Brickwork in progress in the boiler house. A Lancashire boiler is on the left and space for an economiser on the right. A few years later the Lancashire boilers were replaced with Babcock and Wilcox water-tube boilers.

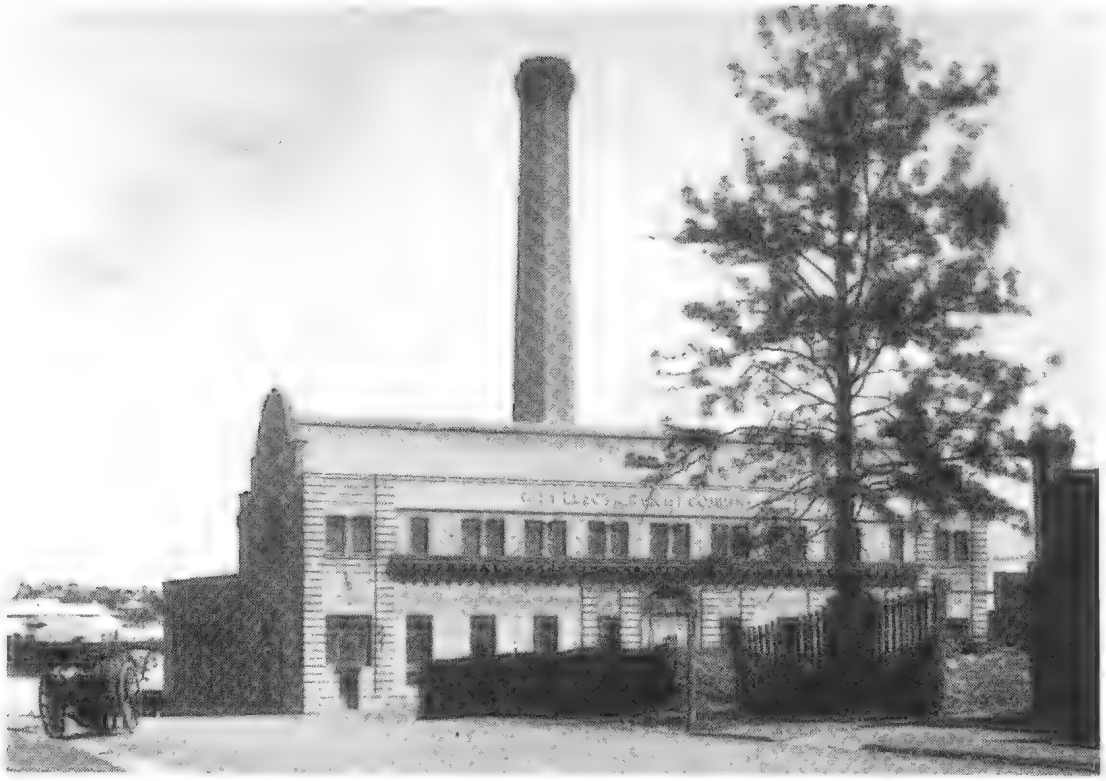


FIG. 66. City Electric Light Co. Ltd William St power station William St frontage. Margaret St is to the left. The Brisbane River is in the distance at the end of Margaret St.

not all of the turbo-dynamos at Ann St as well as some of the boiler plant were moved to William St.

In October 1912, the first turbo-alternator was ordered from Messrs Willans and Robinson Ltd, England and was in operation at the beginning of 1914. This was a 1000 kW, six phase, 50 Hz set connected to a 1000 kW rotary convertor to provide d.c. for the new 440/220 V., 3 wire system which would later replace the 220/110 V., 3 wire system. The alternator was also to supply a.c. for the future a.c. distribution system directly and, after conversion to 5000 V., supply the future motor-convertors at substation No. 1 — to be referred to shortly. Presumably because the 1000 kW set was the largest installed at this time, it was known as No. 1 set.

The 500 kW turbo-dynamo set ordered in 1910 was converted to a turbo-alternator in 1913 and was in operation in October of the same year. It ran in parallel with the larger set and was also connected directly to a rotary convertor of the same rating. The date of providing the first a.c. supply to consumers is not known but it was probably first available on a metered basis in 1917 or 1918 as the purchase of service meters was discussed at this time. Certainly a.c. was available for general supply in 1918 and fortunately the voltage and frequency selected were those which later became the Australian standard, 415/240 V., 50 Hz.

In the period 1914–5 staff at Ann St were transferred to a new building at Boundary St, Petrie Bight, and the Ann St power station was shut down about the same time; the decision to demolish the chimney was made in January 1915.

Vincent's plan for developing William St provided for three more turbo-alternators to be installed over the years 1917 to 1919 (Fig. 62). Each was to be of 2000 kW capacity. However the Company did not adopt this plan but chose to meet the expected rapid growth in demand for electricity supply by ordering a 5000 kW set in April 1916 at a cost of £25,815. (148) The delivery date was presumably to be about a year

FIG. 67. City Electric Light Co. Ltd William St power station. This general view of the engine room, looking towards Margaret St, shows the final installation. Initially the station had only turbo-dynamos but by 1914 two turbo-alternators of total capacity 1500 kW and two rotary convertors of the same total capacity were operating. Three further additions to the generating plant were made up to 1923 when the 12,500 kW set in the middle distance was installed. A rotary convertor, to provide direct current, is seen in the left foreground. The building was about 130 ft long and 50 ft wide. The travelling crane, spanning the full width of the building relieved the problem of handling heavy engine room machinery.

hence but six months after ordering, the supplier advised the Company that because of wartime conditions, no delivery date could be given. In fact it was April 1919 before the new plant arrived and was in operation. Meanwhile there were failures of generating plant including the largest set and in February 1917 the Directors noted that —

> it was unfortunate that the 1000 kW set should have given indications of final failure at this time because the spare 700 kW set is also at present unavailable.

To relieve the situation, a 600 kW set was purchased secondhand from the Sydney City Council in 1917 (149) but it is believed that the plant did not run successfully with the other units. Inevitably the station was overloaded at peak periods.

Later there were further additions to the generating plant (Table 3). The only general photograph known of the interior of the station was taken about 1926 and shows the largest set — 12,500 kW — in the foreground and also the related condensing equipment (Fig. 67). As no cross section drawing of the engine room has been found, that of a very similar station is reproduced in Fig. 68.

A contemporary account dated July 1914 (150) gave the picture of the early stages of development at William St and of the difficulties encountered —

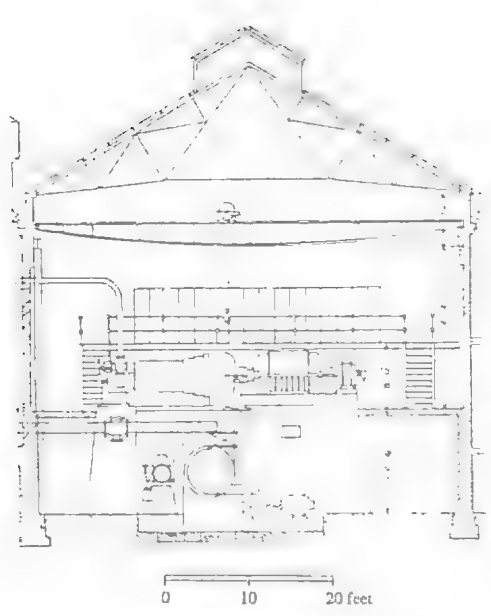


FIG. 68. Cross section of an engine room generally similar to that of the City Electric Light Co. Ltd William St. station.

The extensive additions and improvements which have recently been made to the power-house plant of this company are now in running order, and the unsatisfactory condition of affairs obtaining in the early part of last year has been remedied by a thorough overhaul, very satisfactory in its results. Mr W.H. Vincent, to whom was entrusted the task, joined the company in March 1913, as chief engineer, and at the time of his appointment, was authorised by the directors to obtain any second-hand plant which might be available in Australia to meet the emergency of the breakdown which seemed probable. No such plant at the time was available, and the chief engineer accordingly decided to use every effort to put the existing machinery into such order as would preclude the possibility of serious trouble. His efforts in this direction have been entirely successful, for the plant is now working efficiently and with a much greater degree of economy than was previously the case. The steam consumption, which stood at 7.2 lbs per kWh generated, has been reduced to 5 lbs — a saving of 30 per cent, and a further reduction may be looked for when his scheme of alterations and improvements is completed. The new [sic] 500 kW, 3000 r.p.m. steam turbine, which was formerly direct coupled to two d.c. generators, had now been altered, and drives a Siemens 500 kW alternator. A modern design switchboard is

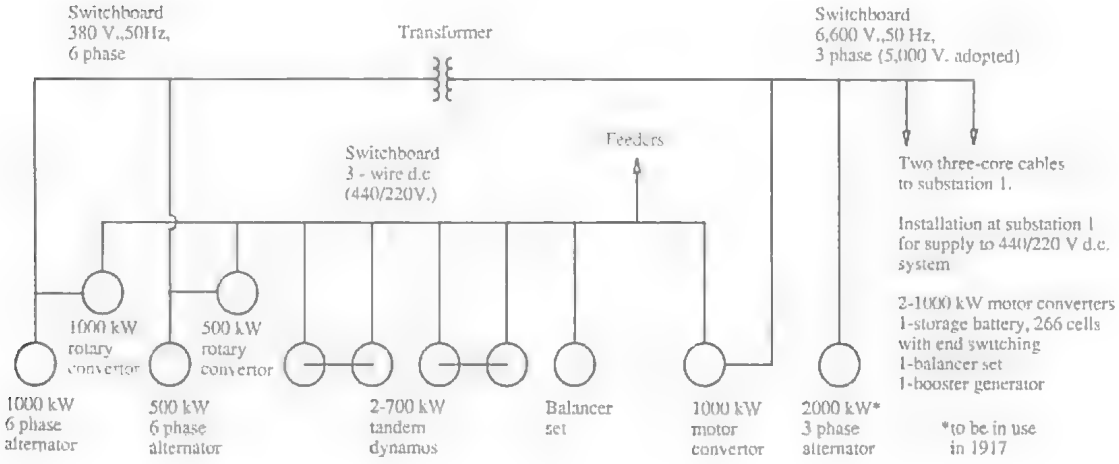


FIG. 69. City Electric Light Co. Ltd William St power station and substation No. 1. The simplified electrical connection diagram shows the proposal, dated 1913, for the development of the power plant at William St and at the substation, to be located at Petrie Bight. The purpose of the substation was to maintain full system voltage over an increasing area of supply. The diagram shows an earlier stage of development than is indicated in Fig. 62. The 2000 kW set was not ordered; instead a 5000 kW, 5000 V. turbo-alternator was installed in 1919. Those familiar with modern power systems will note the considerable variety of rotating plant used to provide a.c. for transmission (and, later, distribution) and d.c. for distribution.

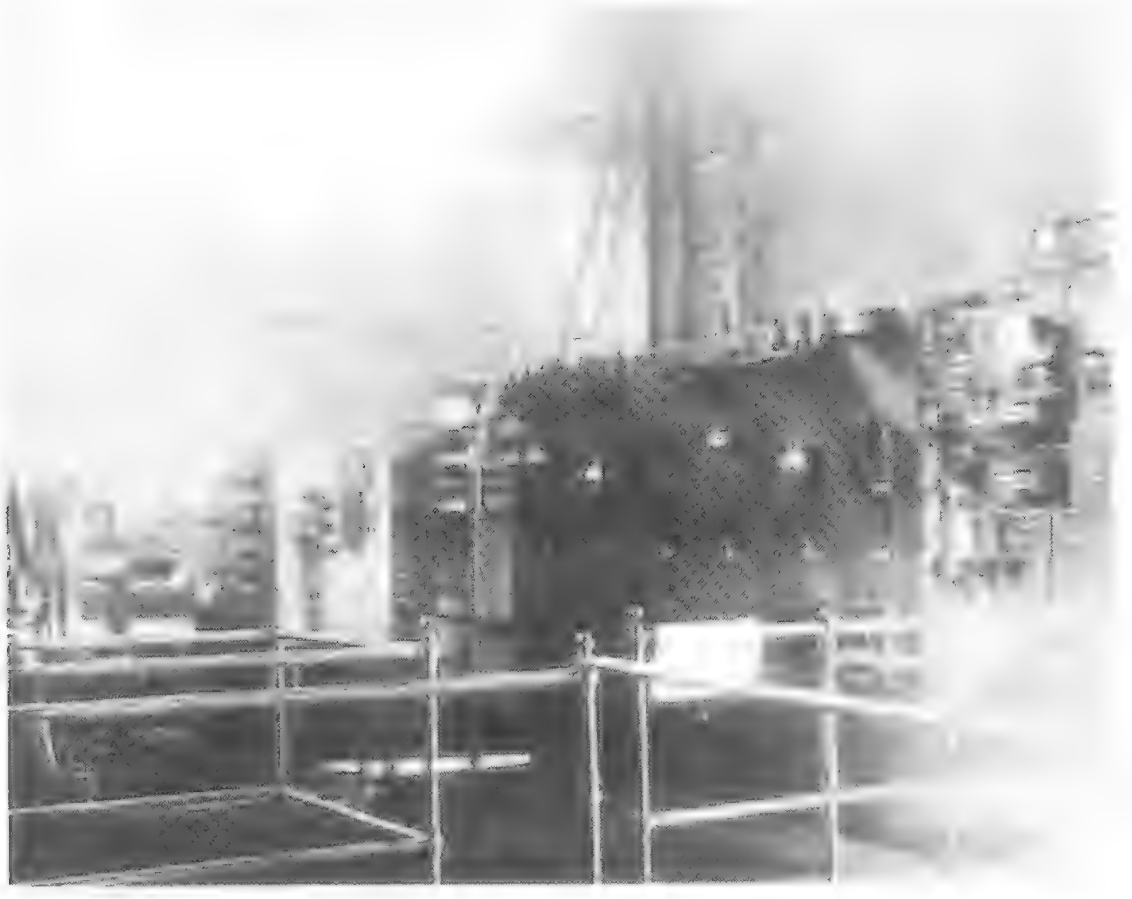


FIG. 70. City Electric Light Co. Ltd William St power station. This switchboard was probably the first for alternating current in the station and would have been for the 500 kW and 1000 kW alternators and rotary convertors. The circuit breakers at the top of the switchboard now replaced the earlier knife switches and fuses. From 1917 or 1918 the distribution system was gradually changed from d.c. to a.c. except for supply to electric motors for which d.c. supply was retained for many years.

being installed, and other additions comprise a 1000 kW turbo-alternator, a 500 kW and 1000 kW rotary converter.

The new 500 kW, 3000 r.p.m. steam turbine referred to in this account was presumably the 500 kW Willans and Robinson turbine which initially drove a tandem pair of dynamos, these being later replaced by a Siemens alternator as stated. The account continued thus —

> The system of current supply is also undergoing a change, being rapidly converted from a three wire, 220 volt system to a 220-440 volt three wire system. As a preliminary to this the balancing of areas throughout the city has been effected by the erection of feeder pillars and the laying of feeder neutrals. This work again has been carried out concurrently with the power house alterations, and has had to be considered in conjunction with them, and no authentic plans of mains having been previously kept, the whole of these and their connections had to be mapped in advance. Good results from these changes have been obtained, and losses in transmission considerably reduced.
>
> The Chief Engineer's arrangements for the future include plans for the probable extension of mains during the next five years, and a converter and battery sub-station situated at Petrie's Bight. This is now in course of construction, and the company's administrative and general offices will be moved into this building on completion.
>
> The whole of the work carried out and the smooth running and economies attained under the present regime reflect great credit upon the skill and forethought manifested, and show what can be effected under unpromising conditions by technical and business ability. Mr Vincent is to be congratulated on the excellent results he has obtained during the comparatively short period of his administration.

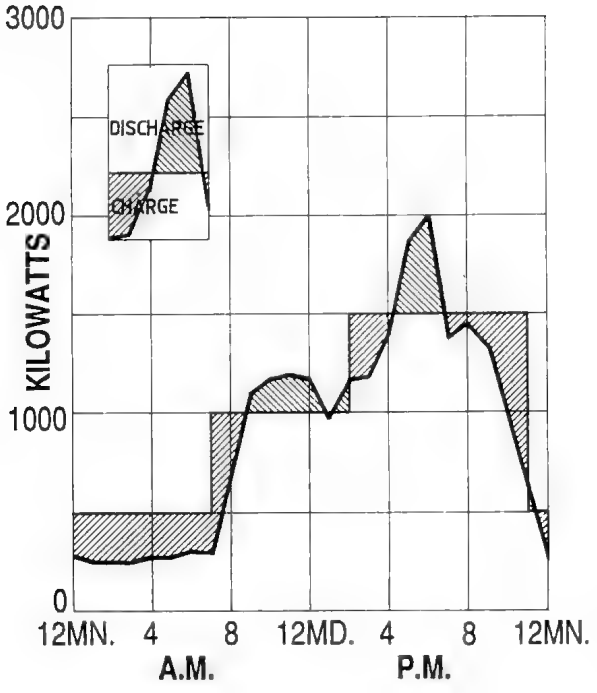


FIG. 71. Daily load distribution diagram for the City Electric Light Co. Ltd as predicted for a week day in June 1915. The installation of a substation storage battery is assumed and the shaded areas denote 'charge' and 'discharge' periods. The consequent evening-out of the power required from the power station generating plant would reduce the cost of operating the system.

The congratulatory last sentence omits the fact that Vincent resigned from the Company on 31 July 1914 — the date that appears at the head of the published article. This was a few weeks after Barton's return from more than twelve months overseas and it is safe to assume that the reported shortcomings of the past were not well received.

Barton resumed his earlier position as Managing Director of the Company from August 1914 at a salary of £650 p.a. In the following month he gave a lecture to the Queensland Institute of Engineers on Condensation Economics in Steam Plant which was followed by a visit to the power station. (151) The paper has not been traced — it would have been interesting to compare his views with those of Vincent.

The plans for the future extension of the mains outlined in the article quoted above included an important new concept aimed at meeting economically the increasing demand. Two options existed: firstly to use larger conductors from the power station so as to ensure that all consumers received supply at about the same voltage, or secondly, to provide substations at convenient points in the area of supply which received power as alternating current from turbo-alternators at the power station. The advantage of the latter was economic since it was more expensive to use larger conductors than to transmit alternating current at a high voltage and then convert this to direct current at the substation. This conversion required the use of motor-convertors which comprised an alternating current motor driving a d.c. dynamo thus transforming the high voltage a.c. to the d.c. system voltage. The a.c. voltage was chosen as 5000, three phase, 50 Hz and was transmitted by underground cables. The first installation was from William St to substation No. 1 in Boundary St, Brisbane.

The one electrical connection diagram relevant to the above development that has been found to date is a proposal only. It shows the equipment at the William St power station, at the substation No. 1 and the connecting cables. A 2000 kW alternator was evidently the first proposed extension of the power station plant. A simplified form of this circuit is shown diagrammatically in Fig. 69 and the first a.c. switchboard is shown in Fig. 70.

THE SUBSTATION BATTERY AND DAILY LOAD DISTRIBUTION: The battery referred to in the same article was to be installed at substation No. 1 and was to provide power during periods when the system load was in excess of the generating capacity at the power station. The requirement was that the battery be charged from the mains supply during times when there was excess capacity at the power station and discharged as required to make up for shortage of capacity. The cost of the battery and ancillary equipment would be offset by the savings resulting from deferment of purchasing additional generating plant. However, these were the days of World War I so it is not surprising that there were delays in obtaining equipment. In particular, the order for the battery had to be changed from a make normally supplied from what had become an enemy country. J.E. Morwood gives the rating of the battery as 3000 ampere-hours; the cost was £9400. (152) The substation was finally put into operation in April 1917. (149)

Fig. 72. City Electric Light Co. Ltd William St power station showing part of the installation of Babcock and Wilcox water-tube boilers with chain grate stokers. The completed installation comprised three two drum and five three-drum units. The specified steam conditions for the larger units were 210 lb. per sq. in. and 600 degrees Fahr.

Considering the important role of the battery, it seemed possible that there were earlier — no doubt smaller — installations elsewhere in the Company's area of supply. Barton had considered a battery installation in the 1890's, because his 'Work Register' (68) and 'Goods Received' book (153) give diagrams and calculations relating to this. Probably about 1895 he sketched load distribution diagrams (in which the electrical load on the system is plotted against time of day) (Fig. 38). On a page headed 'Uptown Accumulator Plant' he included diagrams for a few days in 1893 and 1895 and showed the effect of a 2000 ampere-hour battery in taking peak and night loading. His calculations were based on increasing the peak load capacity of the Edison Lane station by 450 lights (c.27 kW), charging the battery for about 8 hours at times of light load and obtaining from it about 250 A. for 5 hours at times of heavy load. He concluded that with a capital investment of some £800 his sales of energy would increase by about £300 p.a. There is no mention of a battery in lists of the Company's assets so it is very likely that Barton's ideas were purely speculative.

He next referred to a battery when writing to W.M.E. L'Estrange in 1897 in these terms —

> One piece of apparatus however will cause a regular annual expenditure for renewals, namely the accumulator battery. (107)

This may have been a prediction relating to operation at the Ann St station or be based on present experience with an installation at a site unknown.

In October 1899, Barton made more calculations based on relieving the expected peak loading of the Ann St station. He considered a 250 V. battery of under 400 ampere-hours which would provide 160 A. for an hour of peak loading and much smaller

currents in the early daylight hours, and for 6 hours at night. As far as is known, no such plant was installed. Again in 1903 Barton was considering the installation of a battery in the Fortitude Valley area to supplement the 220/110 V. system. This was one of capacity 1000 ampere-hours at a cost of about £1500 but evidently no such plant was installed. It is significant that F.R. L'Estrange's many articles and other records mention only the substation No. 1 battery which leads one to the view that in spite of earlier references this may have been the first actually installed by the Company or its predecessors as part of the power system.

No records of the day to day performance of the William St power station or of the combined performance of the station and substation 1 have been found. However predictions for the combined performance were made for the month of June for each of the years 1914 to 1920. (146) This information is in the form of stereotyped load distribution diagrams (Fig. 71). In each diagram — including that for 1914 — the important intended role of the battery is shown with a number of periods each day and night of charge and discharge. Another feature of the projected operation was that generators of different capacity were to be utilised in turn each to run at 100 per cent load factor. It can only be surmised as to whether or not this ideal situation would have proved practicable.

SOME DESIGN ERRORS: To conclude the story of the early stages of development of the William St station there should be some reference to the boilers, the coal handling plant and the circulating water system. The 1914 account already referred to discusses the problems relating to these and the steps taken to deal with them up to August of that year. The first stage of the replacement of the initial installation of Lancashire (fire tube) boilers with the more modern Babcock and Wilcox (water tube) type with mechanical chain grate stokers (150) is described thus —

> The work of installing this plant has been attended with considerable difficulty, as it has involved the erection of new plant simultaneously with the repair of old, while the ordinary requirements of current had to be daily satisfied. Further, the housing of new plant not having been considered in connection with the dimensions of the power-house, it has been necessary to raise the roof of the boiler house seven feet and new flues constructed. Another economiser consisting of 576 tubes, a ten-inch steam main and a system of feed pipes providing a hot and cold feed are further additions in this connection.
>
> Great trouble has been experienced with the circulating pumps owing to the sinking of the pump house foundations, situated on a mud bank, causing inefficient working. This pump house, now collapsed, has been replaced by one of modern design, the foundations for which extend in depth to the rock foundation on the river foreshore. The well is of sufficient capacity to deal with a load of 6000 kW, and the circulating water system has also been revised and improved, so that the nuisance of the intake pipes becoming clogged with mud and water hyacinth has been abolished.
>
> As part of the Chief Engineer's scheme, a system of coal bunkers of 500-ton capacity, with conveyors, has been designed, the material for which is now arriving. The conveyors will feed the coal direct to the bunkers, from whence it will descend by gravity to the furnaces; this will effect a considerable saving over the method formerly in use. (Fig. 72). (150)

It is difficult to understand why in about 1909 fire-tube boilers were initially selected for the new power station when water-tube boilers with mechanical stokers had already been installed in many Australian power stations. These included the Brisbane Tramways Co., the Railways Workshops at Ipswich and Mt Morgan mine. In the light of experience the low headroom in the boiler house, which required costly structural alterations before the newer boilers could be installed, appears to show lack of foresight. The records of Messrs Babcock Australia Ltd show that the first water-tube boiler was ordered in April 1912, the next two in February 1913 and two more in March 1919 bringing the capacity to over 100,000 lbs of water evaporated per hour, the highest steam pressure being 210 lb. per sq. in. There were later additions following orders in 1921 and 1924. (154)

BARTON AND THE COMPANY MANAGEMENT: Apparently there was no immediate replacement for Vincent as the next reference to staff in the Minutes of the Directors' meetings is in May 1915 when it was noted that Barton was in Sydney in connection with the appointments of E.J. Cochrane and J.S. Just. The result was that shortly afterwards Cochrane became Engineer and Manager of the Company and Just the Assistant Engineer, Edward Barton continued as a Director after relinquishing the top position and was retained as a Consultant with a salary of over £500 p.a. When at the end of 1915 he decided to travel to England to engage in war work, the Directorate gave him

six months leave of absence. This was evidently extended as he was still a Director and a Consultant in February 1917. At the time E.J. Cochrane ceased to be Engineer and Manager because of ill health and accepted the position of Advisory Engineer to the Company. (149) He advised Barton that he was vacating the Engineer and Manager position saying that (he) Barton 'might return to look after his interests.' Barton replied that 'he shall return if offered passage via America and salary of £1000 per annum.' The reply from the Directors was very explicit and read —

> your cablegram stop Directors have no intention of asking you to take over management stop require to know if you wish re-election as a Director at General meeting to be held next month reply immediately.

Barton apparently did not reply promptly but a fortnight or so later appointed W.J. Young, a fellow Director, as his proxy to vote at all meetings. At the same time the Directorate extended Barton's leave of absence to June 1917. Cochrane died in April 1917.

In November 1917 this leave was further extended to 31 March 1918; however, shortly before the latter date the Directorate cabled Barton pointing out that the Board intends to elect W.M.E. L'Estrange in his place. In due course Barton cabled his reply — 'quite content'. In May 1918, while still in England, he was involved in assisting with the procurement of the long awaited 5000 kW turbo-alternator or rather the replacement for the one originally ordered which had been 'commandeered' by a body with a higher priority. In the same month there is a reference in the Minutes of a meeting of the Directorate, to the renewal for another five years of arrangements between Barton and the Company — presumably retaining his services as a Consultant.

In 1920 Barton was appointed a Director of the Ipswich Electric Supply Co. Ltd which had been formed in 1917 and was initially an offshoot of the City Electric Light Co. Ltd. He held this position until 1925, attending meetings in 1920 and 1921.

As has been seen Barton kept in touch with developments in Brisbane and Ipswich notwithstanding his preference for living abroad. After 1925 his direct interest would have been as a shareholder in both Companies. He kept up a correspondence with W.M.E. L'Estrange and in a 1926 post card from Paris remarked that —

> it would appear from press cuttings that you will all be civil servants or else out looking for employment with cash in your pockets from the sale of the CEL Co business.

This referred to the then current possibility of purchase of the Company's assets by the Brisbane City Council. This did not eventuate as the Council and the Company could not reach agreement on the value of the Company's assets. The consequences of this disagreement were very far reaching but a discussion of them is outside the scope of this biography. The background and the sequence of the subsequent events are briefly explained by Morwood. (152)

THE OVERHEAD MAINS PROBLEM: Concurrently with the developments just described and in fact ever since the introduction of the Electric Light and Power Act of 1896 there had been concern that restrictions on the use of overhead wires for the distribution of electricity had been too drastic. A deputation representing the Queensland Electrical Association, including Barton, met the Minister for Public Works in October 1909 and it was explained that this restriction had seriously limited the growth of the electricity supply industry and only four country towns in Queensland had electric light. Barton explained that the Act provided that no overhead wires could be used except in the manner prescribed and then only with the permission of the Minister and the Local Authority. This meant that when wires were placed above ground in accordance with the regulations they could be ordered by a local authority to be removed if it was considered that 'such line is or is likely to become dangerous to public safety.' In this connection Barton commented that —

> underground wires were practically prohibitive in cost and it meant that outside the 'wood block' [central city] area electricity could not be applied remuneratively in Brisbane.

The Minister undertook to refer the matter to experts and stated that he would submit their report to Cabinet. (155) The outcome was an Amendment Bill introduced in September 1911 to remove the restrictions on overhead lines but this was defeated after a lengthy debate.

Evidently there was no change in the situation over the next few years because at the Annual Dinner of the Queensland Institute of Engineers in April 1914, the Vice President (N.M. Bell) was reported as saying that —

> he would like to see a little more liberality shown

> with regard to the electric lighting of the city and desired the removal of the present harassing restrictions with regard to the overhead and underground mains.

The same report quoted the Acting Premier, who represented the Government at the Dinner, as replying that —

> there might be a chance of the re-introduction of the Bill which was so badly beaten in the Upper House. (156)

In the event, the matter was not brought before either House.

However, in July 1917 the City Electric Light Co. Ltd made an application to the Minister for Works and the Brisbane City Council for permission to run overhead mains in North and South Brisbane and in October formal approval was given. This was the year in which the Company was asked by the Brisbane Town Clerk to submit proposals for electric lighting of the city streets. The Company's plan was accepted — obviously anticipating formal approval by the Government — and on 17 July 1917 the first lights were switched on by the Mayor of Brisbane, almost thirty years after Barton's original proposal.

A major local step in the technology of high voltage a.c. transmission was taken about this time despite the fact that the wording of the Electric Light and Power Act imposed serious restrictions on overhead lines. The City Electric Light Co. Ltd and the then recently formed Ipswich Electric Supply Co. Ltd agreed on a plan by which the former supplied energy from their William St power station and transmitted this some 20 miles by overhead line at 33,000 volts to the latter for sub-transmission at 5000 volts and distribution at the standard voltage of 415/240, as in Brisbane. The major equipment was ordered in June 1918 and the system switched on in August 1919.

With the very recently gained experience of a transmission voltage of 5000 it was indeed a courageous decision although it can be assumed that the design of the 33,000 V. line was based on overseas practices because such voltages had been in use since about the turn of the century.

The success of the plan in terms of demand is evident from a report that the full capacity of the line was reached within a year and duplication was under consideration. At a meeting of shareholders of the Ipswich Electric Supply Co. Ltd in August 1920, Barton expressed his 'emphatic opinion that the Company had done marvellously well.' (157)

RECORDS OF GROWTH IN ELECTRICITY SUPPLY GIVEN BY BARTON, WHITE AND CO. AND THEIR SUCCESSORS (APPENDIX D): This account would not be complete without an attempt at collating at least part of the scattered information showing the growth in demand for electricity supply from the Company and its predecessors during the period in which Barton had a major influence on the development of the industry i.e. 1888 to 1915. Because of the phenomenal growth between 1916 and 1920, data for these years have been included although Barton's role was as a Director and Consultant up to March 1918 and as a Consultant only thereafter.

Annual statistics for the first decade are almost negligible and even for the remaining period are incomplete with the exception of the period 1898 to 1911 inclusive during which electrical quantities were included in the returns published in the Queensland Government Gazette. However the trends in growth of the demand for electricity supply are evident, particularly the steady improvement after the first decade. Comparing the figures for annual energy generated, it is clear that after about a decade at Edison Lane the number of kilowatt-hours used was 0.18 million; after the subsequent 12 years of operation at Ann St this rose to 2.1 million and a decade later — in 1920 — the third of the series of three power stations produced over 18 million in one year. Growth was restricted by generating capacity during World War I in spite of the increase in maximum demand during that period. The effect of adding two 5000 kW sets immediately after the war was remarkable by any standards.

It is not intended to attempt to review the financial operations of the City Electric Light Co. Ltd or its predecessors beyond saying that shareholders denied themselves a dividend for many years as they were anxious to husband their reserves. The first dividend was paid in 1905 and then only to preference shareholders who received 6 per cent. In 1907, ordinary shareholders received a dividend and thereafter there were annual dividends to both groups. It would have been particularly gratifying for Barton to watch the progress of the Company after the early very difficult years. In 1915, the year that he left Queensland to undertake munitions work in England, the Company records for the twelve months ending 31 January 1915 showed a profit of £31,013, dividend payments of £20,589 and accrued reserves of £24,217. Barton himself held 14,341 £1 shares out of 81,036, the total registered.

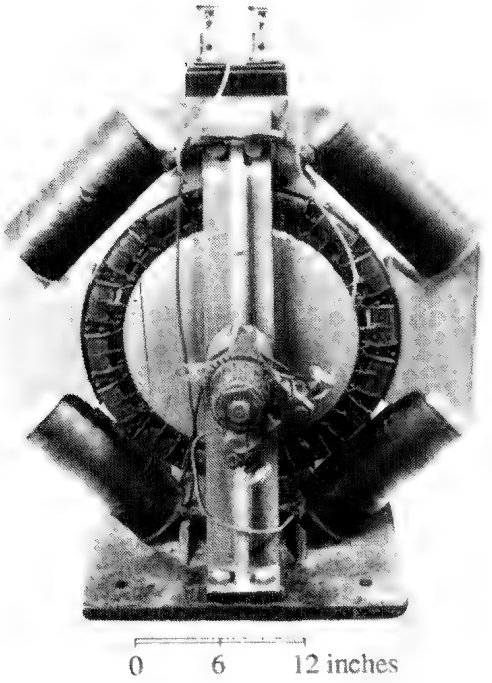


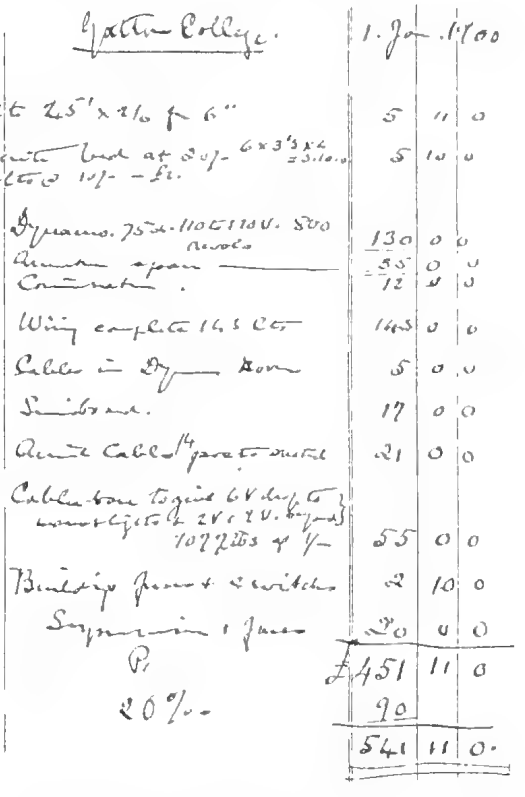
FIG. 73. Dynamo used at Teddington, near Maryborough, Queensland to provide lighting at the pumping station. It was designed and constructed locally in c.1888 and was possibly the first to be made in Queensland. Power was supplied by an 8 h.p. steam engine. The dynamo generated a voltage of c.60 but the capacity is not known. It is preserved in the Queensland Museum.

COUNTRY AREAS, 1889 TO 1900

TOWNSVILLE TO THE TWEED RIVER: During the first decade of Barton's pioneer work in Queensland he prepared quotations for numerous electric lighting installations. (153) There are occasional references to these in contemporary periodicals and, in the absence of Company records for this period showing which quotations were accepted, such references have provided some idea of the firm's activities. The localities ranged along the coast from Townsville to the Tweed River and as far inland as Thargomindah. The Thargomindah installation is recorded in some detail since it is believed to have been the first artesian bore operated station in Queensland.

Chronologically, the first record shows that in mid-1889 Barton, White and Co. supplied and erected an electric lighting plant for a large butchering and freezing establishment in Rockhampton. (85) In April 1890, they provided electric lighting in Ipswich in the Building Society's Hall. (91) This was the first introduction of electric light in the district and as such created great interest; it was not until six years later that the Government Electrical Engineer suggested to the Ipswich Council that they should introduce electric lighting.

Rockhampton was cautious about lighting the town and the firm's work there in August 1890 was limited to an extensive electric bell installation. (158) They were more successful in Maryborough as in 1891 they supplied the Maryborough Exhibition with electric lighting apparatus. (159) Shortly afterwards the firm provided arc lighting in the foundry of Messrs Walkers Ltd of Maryborough and there were discussions about lighting the town. (95) Barton would have taken the greatest interest in a small 60 V. dynamo designed and constructed in Maryborough by local engineers for lighting the local pumping station (Fig. 73). (97)


Gatton College. 1. Jan. 1900

Belt 25' x 2½ @ 6" 5 11 0

Engine bed at £ s. d. 6 x 3'3" x 4 = 23.10.0
4 Bolts @ 10/- = £2. 5 10 0

Dynamo. 75 K. 110 C/110 V. 800 revs 130 0 0

Armature spare 55 0 0

Commutator. 12 0 0

Wiring complete 14.5 Cct 145 0 0

Cable in Dynamo Room 5 0 0

Switchboard. 17 0 0

Arc to Cable 4 panel to match 21 0 0

Cable from Engine 6 V dynamo to Switchboard & 2 V. 2 V. Dynamos 107 lbs @ 1/- 55 0 0

Building fuses & switches 2 10 0

Supervision 1 Jan 20 0 0

£451 11 0

20% 90

541 11 0

FIG. 74. Brisbane Electric Supply Co. Ltd installed electric light in Gatton Agricultural College in 1900. Barton prepared the estimates for the electrical part of the installation, summarised in this facsimile copy.

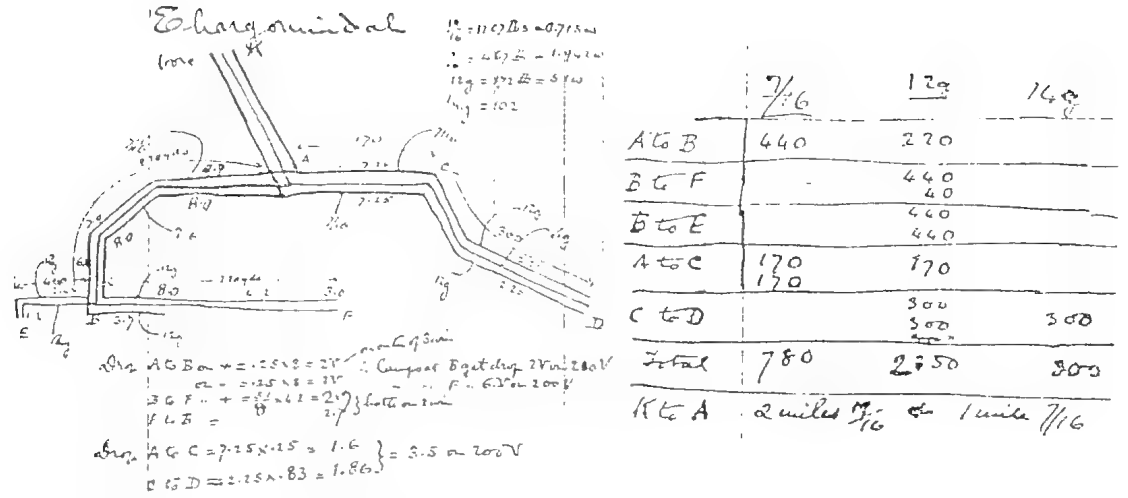


FIG. 75. Development of the artesian bore power station at Thargomindah, Western Queensland. Barton designed and was responsible for the construction of the overhead mains connecting the power station to the town and for the electrical side of the power plant. The 440/220 V. three wire distribution system was in advance of the conventional 220/110 V. three wire system in use in Brisbane. The diagram and calculations are from Barton's notebook, probably c.1897.

The firm was active in fitting up sugar mills at this time. Examples were extensions to arc and incandescent lighting for Robb and Co. at Tweed Heads, NSW and exterior and interior lighting at A.H. Young's Fairymead plantation at Bundaberg. Floods in the Gympie area in the winter of 1891 prevented the Company carrying out more electrical installations at gold mines there. (160)

About August 1892 Barton and White provided electrical generating plant and switchboards for the new works of the Queensland Meat Export and Engineering Co. in Townsville. This was a 110 V. d.c. system and the switchboards were manufactured in the firm's Brisbane workshops. (101)

No records of country work in 1893 have been found; no doubt projects were held up as a consequence of the wide-spread floods. However during this year, Barton was developing a wet separator to remove magnetic material from gold bearing ores. Sketches and estimates have been found in one of his note books showing that the work was being carried out for the Biggenden Gold Mining Co. (153)

In 1894 the firm extended the lighting at Mon Repos sugar mill (near Bundaberg) and also provided lighting at Doolbi station (near Childers) for Robert Cran and Co. (111)

No records of country work in 1895 have been found other than the supply of magnetic separators to gold mines 'in the north', as mentioned earlier. With the firm's major financial problems during 1896 it is not surprising that regular reports on their work were curtailed. However during the months of May and June 1897, Barton wrote to the provincial towns of Townsville, Bundaberg, Mackay and Maryborough on behalf of an unidentified Company — the Queensland Pioneer Electric Light Syndicate, Edison Lane, Brisbane — seeking consent of the local Council for Barton to organise electricity supply in their immediate area. Presumably this would have involved applying for an Order in Council on behalf of the Town Council and then seeking to raise finance for the plan. No details have been found and evidently nothing came of these approaches; further, no later reference to the Syndicate has come to light. However, in June 1897 there is a reference to the lighting of the town of Toowoomba by the Brisbane Electric Supply Co. Ltd, and this was the year that the Toowoomba Electric Supply Co. was formed. (161) For some reason the Order in Council was revoked in 1900 to be later transferred to Thomas Tonks, a Brisbane electrician. The new Company was described as the Thomas Tonks Electric Light and Power Co. Ltd but in the following year, 1906, became the Toowoomba Electric Light and Power Co. Ltd. In November 1900 it was reported that the Brisbane Electric

FIG. 76. The artesian bore power plant at Thargomindah was housed in a simple corrugated iron building at the bore site. A section of the overhead mains, carried on insulators, wooden crossarms and poles is in the foreground. The discharge from the water-wheel driving the dynamos is seen to the right.

FIG. 77. The artesian bore power plant at Thargomindah was driven by a locally designed and manufactured water-wheel (similar to a Pelton wheel) housed in a casing made from a ship's water tank. The wheel had 16 buckets arranged radially with an overall diameter of 24 in. The bore pressure was initially 245 lb. per sq. in. The nozzle and supporting structure were probably moved temporarily from the working position for this photograph.

FIG. 78. The artesian bore power plant at Thargomindah. The water-wheel shafting was directly coupled to two dynamos, one on either side. These were designed by Barton and rated at 220 V., c.5.6 kW each. They were manufactured in Brisbane by Barton's firm and were commissioned in March 1898.

Supply Co. Ltd was carrying out an electric lighting installation of some 160 16 c.p. lamps at Gatton under the supervision of the Government Electrician. (162) This would have been at the Gatton Agricultural College and, from Barton's estimates prepared in January 1900, a dynamo of about 10 kW, 110 V., a switchboard, overhead distribution mains and interior wiring were provided for about £540. (Fig. 74) (153) There was presumably no objection here to the use of overhead mains.

THARGOMINDAH — A UNIQUE DEVELOPMENT: The name Thargomindah, a town located 700 miles west of Brisbane, and that of Barton and White were associated in various addresses and publications of some fifty years ago and the town is of unique interest on account of the setting up of the first artesian bore operated electric power plant in Queensland. It is recorded that the town had a small steam-engine driven electrical generating plant in early 1892 which was described thus —

> To Trackson of Brisbane falls the honour of carrying out the first electric street lighting of a permanent character in the Colony. The town of Thargomindah has been fitted out by them with an incandescent system, the lamps varying in power from 16 to 500 candles. The dynamos are of the Firth type and it is proposed to use the power for various purposes during the day ... (163)

The next report was in January 1893 when the *Queenslander* stated that —

> the town was lit by electricity for the first time last night, [23 January] the innovation proving a great success. The machinery which was erected by a local man named Simpson worked smoothly. The plant belongs to Mr Paterson, a storekeeper. It is understood that a great number of houses will use the light. (164)

The reports are clearly inconsistent; possibly there was considerable delay in completing the initial installation or for some reason this plant was replaced. There is no evidence that Barton was involved at this stage.

FIG. 79. The artesian bore power plant at Thargomindah. An improved water-wheel replaced the original one in 1904 or earlier. Evidently only one dynamo was in service at the time of the photograph.

An artesian bore had been put down under a contract let by the Government, and from which water was first available in September 1893. The local authority — the Bulloo Divisional Board — leased the bore from the Government for the reticulation of water in the town and for the generation of electricity for £100 per year for ten years from 1 July 1895. (165)

About this time it was reported that, owing to the expense, electric lighting of the town had been 'abandoned for kerosene.' (166) The same information appeared annually until 1900 when the corresponding entry read —

> The town is now lit by electricity, the flow from the artesian bore driving a water-wheel connected to two dynamos.

This summary of the situation was a little belated as the date of inauguration of electricity supply using the bore is given in the *Queenslander* as 30 March 1898 with a preliminary trial held at least as far back as May 1897. The trial installation was described as an experimental stage dynamo capable of supplying 75 16 c.p. incandescent lamps, the bore providing the power through a water-wheel. (167–169) Wires were to be run from the generating plant to the township 'within a fortnight and the work will then be complete.' This prediction was not realised and it is doubtful whether the equipment ordered from the Brisbane Electric Supply Co. Ltd was yet available. The following extracts from an article in the *Queenslander* described the inauguration of the lighting and gave a full report of the installation —

> A successful concert in aid of the hospital was held last night [30 March 1898]. Electric wires from the artesian bore a mile beyond the town were attached to the town wires yesterday and the hall in which the concert was held was brilliantly lighted by electricity. The light was beautifully clear and uniform and everyone present pronounced the light to be a great success ... The electric lighting of Thargomindah will be finished in about three weeks ... We are informed that this is the first municipality-owned electric plant in Queensland and began with the purchase by the Divisional Board of the small plant which the late Mr Paterson, an enterprising saw-mill owner, started there. Having gone so far, the council went into the matter carefully and with the comment

Fig. 80. The artesian bore power plant at Thargomindah. The marble switchboards for the control of the electrical plant and the indicating instruments for the measurement of the output were manufactured c.1898 by Barton's firm, the Brisbane Electric Supply Co. Ltd.

and advice of Mr Hesketh [the Government Electrical Engineer] decided to adopt the three-wire, 440 volt system of distribution as this enabled them to make use of the water power of the artesian bore which is situated at a distance of one mile from the town. The current is carried to the town by cables weighing 1½ tons and by the ordinary 110 volt system of distribution the weight of the cables would have been 16 tons, which is quite prohibitive in capital outlay. The plant is particularly interesting in that the water-wheel (Pelton type) was made in Thargomindah under the designs of Mr Holmes, the engineer to the Board, while the dynamos and switchboard were made by Messrs Barton and White of this city from Brisbane castings and forgings. The two dynamos are placed on either side of the water-wheel and connected to the shaft so they had to be designed for a specially low speed. The speed of the water-wheel is regulated by an electrically controlled governor which opens the water valve as the number of lights in the town is increased and cuts off the water as the load decreases. The current from the dynamos is led to the cables on the poles through a switchboard made of white marble on which are mounted two voltmeters and two ammeters to indicate the pressure and quantity of the current being consumed in the town. The voltmeters are fed by return pressure wires so that they constitute a telltale informing the engineer at all times of the pressure and therefore of the brilliance of the lights in the town over a mile away. (169)

The foregoing account is supplemented by a paper by Hesketh and by a quotation from Barton, on behalf of his firm, for the electrical equipment and distribution system. Hesketh gave details of the hydraulic side of the installation thus —

> The bore is 2650 ft in depth, the surface of the ground being 495 ft above the sea level. The pressure when the bore was first opened was 245 lb. per sq. in. and the daily flow estimated at 670,000 gallons with a temperature of 166° F. For the purpose of electric lighting, a jet drives a locally made water-wheel (a photograph of which was shown). The wheel was on the Pelton principle but its details were not strictly orthodox. There were sixteen buckets on the wheel which had a diameter of 24 in. on the outside of the buckets. The nozzle had a diameter of 1¼ in.

More details of the electrical side were given thus —

> The distribution from the central station was by means of overhead wires on the three-wire system. In the author's opinion electric lighting undertakings would be considerably handicapped if permission was not given for the use of overhead conductors in such cases. Owing to the fact that timber is very scarce, the poles and general outside construction could not be said to be very artistic. The wiring inside the houses was of the usual pioneer style. There were sixty lamps already connected, and forty more to be connected shortly. With a view of ascertaining what power could be obtained from the bore, tests were made, and the results tabulated, from which it appears that, although the total (electrical horse power) available with the present plant is ten electrical horse power, it would be possible to obtain fifteen electrical horse power with a more efficient water wheel. (170)

Barton gave further information in his quotation for the installation and also left on record his calculations in connection with the design of the distribution system (Fig. 75). The station equipment was shown thus —

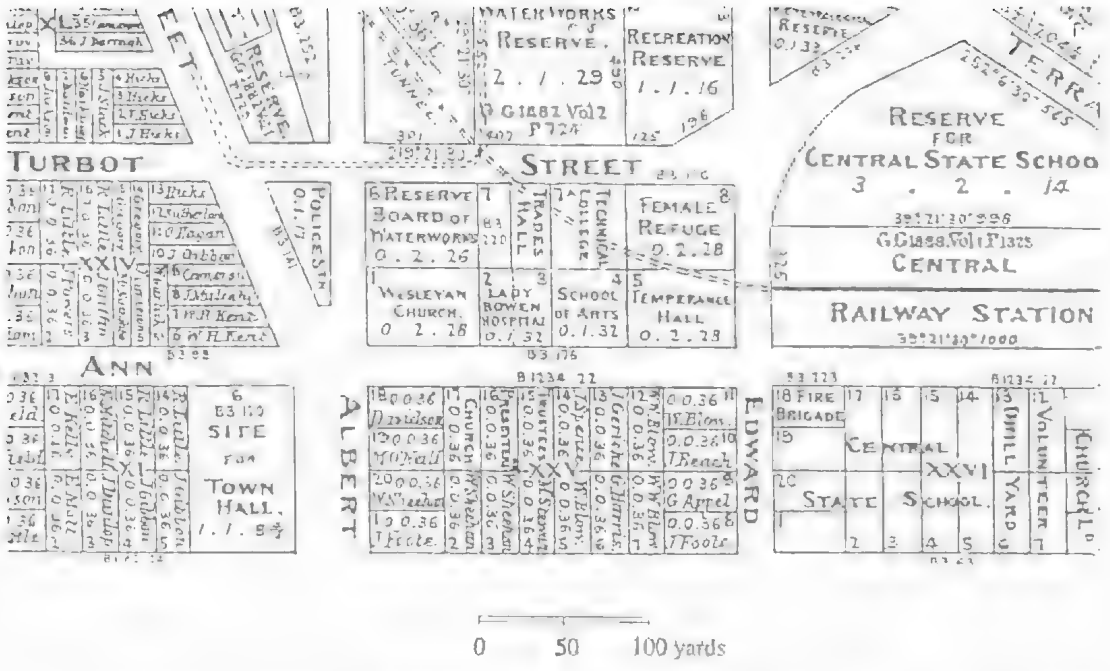


FIG. 81. The Brisbane Technical College was set up as part of the Brisbane School of Arts to meet the demand for technical courses. A building provided for this purpose was erected facing Turbot St c.1884 in the area behind the School of Arts. Barton gave his lectures in this building for many years beginning in 1889. It was also a meeting place for the Queensland Electrical Association in the 1890's.

> 2 Dynamos. 100 lights, 220 V., 800 n [r.p.m.] £210
> 2 Electric Governors £30
> Switchboard, Instruments and switches £28
> The distribution conductors and insulators were shown as costing £168, making a total of £436 and accompanying this were calculations of the estimated currents, voltage drop etc. (153)

The dynamos would have to be used as a pair to supply the 440/220 V. 3 wire system and it is of interest that the use of such a distribution voltage was a development some fifteen years ahead of Brisbane practice.

The power station building is shown in Fig. 76, the original locally made water-wheel in Fig. 77 and the general arrangement of the plant in Fig. 78. The next development with a more efficient water-wheel is shown in Fig. 79 and the switchboard details in Fig. 80.

There is evidence that the water-wheel was replaced by a conventional Pelton wheel during or before 1904 (Fig. 79) with a more usual form of casing in place of the original one said to have been made locally from a ship's water tank. Whether the dynamos were also replaced is not known but it may be significant that the rating of the installation in 1935 was given as 24 kW. The plant was finally closed down in 1951 and replaced with a diesel engine driven generator.

There was a problem over the Order in Council which was necessary to legalise the 1898 installation and distribution system although this did not prevent the scheme going ahead. It was Hesketh's responsibility to advise the Government on technical aspects of the Electric Light and Power Act and here was a clear breach of it in regard to the overhead mains. He had inspected the area in September 1898 and noted —

> that he did not see how the Electric Light scheme would be commercially practical if overhead conductors were not approved (171)

This argument was accepted by Cabinet but for some reason the Order was not gazetted until September 1899.

As a general comment on this pioneer development, it is surprising to discover how few Queensland country towns were prepared to go ahead with electricity supply schemes about this period. Even in 1918 when the demand in Brisbane was increasing rapidly, and twenty years after the Thargomindah artesian bore plant was commissioned, only five country

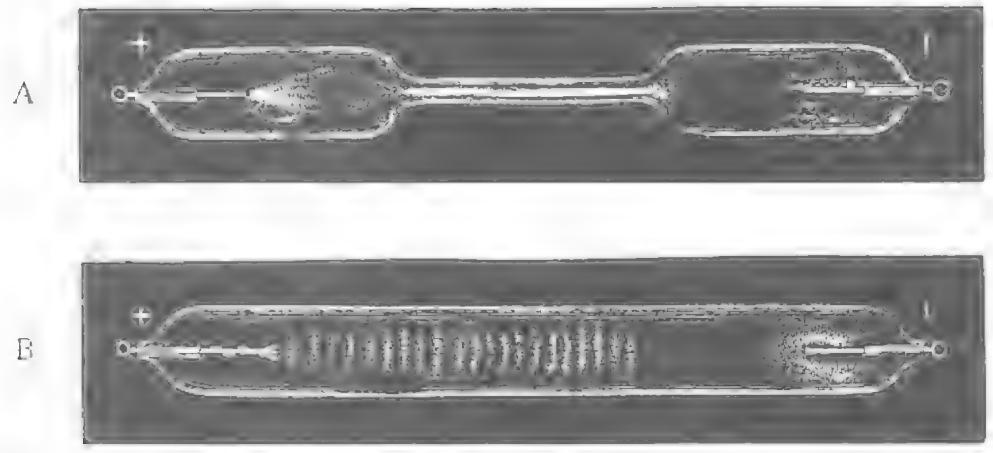


FIG. 82. In early lectures on electricity, electrical discharges in partial vacua were demonstrated by means of Geissler tubes which were available in great variety. The thin-walled, glass tubes had platinum electrodes and contained gases with various degrees of vacuum. **A**, had a narrow portion which facilitated spectrum analysis. **B**, contained carbon dioxide and the glow appeared as a series of cupped discs. Development of these tubes led to the modern fluorescent light which was introduced commercially in the mid 1930's.

towns had electric lighting

This Chapter spans the period from 1888, when the first commercial electricity supply was given to Brisbane, to the early twenties. For most of this time Barton provided leadership despite many disappointments and financial setbacks. His name is now forgotten by the community and few artefacts relating to his work remain; however, records of the period show the extent of his contribution.

CONTRIBUTION TO EDUCATION AND PROFESSIONAL ENGINEERING SOCIETIES — 1889 TO THE EARLY 1920's

EDUCATION

THE BRISBANE TECHNICAL COLLEGE AND RELATED INTERESTS: The credit for the development of courses providing technical training in Brisbane must be given to the Brisbane School of Arts which was founded in 1849 and in 1878 moved from the corner of Queen and Creek Streets to Ann Street. (Fig. 81)

In 1882 the Committee of Management of the School gained Government support for the setting up of a Technical College which was to be part of the School. (172) A Government grant in 1883 or 1884 enabled a building for the College to be erected at the back of the existing building. This comprised a large hall, a mechanical drawing room and a general class room. In addition, a brick outhouse for a chemical laboratory and a wooden shed for carpentry were provided. The College also had the use of three rooms in the School of Arts building.

Facilities were organised for the teaching of a variety of subjects many of which, though rudimentary, were basic to engineering and the forerunners of organised technical education courses. As an example, in 1884, the subjects taught in evening classes included Mechanical Drawing, Freehand Drawing, Mathematics, Chemistry, Geology and, just offered, Applied Mechanics. The last subject was advertised with the lecturer's name, Thomas Tomlinson. (173) In the early days, in addition to the standard courses, occasional single lectures were given on specific subjects e.g. a lecture by Professor Pepper on electrical discharges in gases using Geissler tubes (Fig. 82) was reported in the *Brisbane Courier*. (174)

In July 1889, a year after the first commercial supply of electricity in Brisbane, we find Barton undertaking to give a series of ten lectures on electricity. These were held on Monday evenings in the Technical College building, the admittance charge for each lecture being one shilling. (175) The subjects may be summarised thus: static and dynamic electricity, dynamos, static induction, transmission of

FIG. 83. Facsimile of a list of lecture topics prepared by Barton for two of his courses at the Brisbane Technical College in the late 1890's.

electricity, electrodeposition of metals, telegraphy and telephony. Incidentally, the series was suddenly curtailed when Barton was required to attend to the lighting at Parliament House on Monday nights as well as continuing his normal attendance on other week nights; later an alternative arrangement at the House enabled him to proceed with the series which was followed in October by a similar but more practical course. (176,177) At the end of the year there was an examination and one of those who passed was W. Young — possibly the employee of Barton, White and Co. who later became a Director of the Brisbane Electric Supply Co. Ltd. Thus began the slow development of technical education in electrical engineering in Queensland.

In 1890 the ninth session of the technical classes began and in January Barton commenced a series of Physics lectures. The opening lecture was free and the series cost 10/6 with the classes running from 7 to 8.30 pm. (178) Many lectures were reported in some detail in the Press and it is probable that there were twenty in the series.

Barton continued his lectures in 1891 and in 1892 about twenty were given between June and November. Most were reported in the *Queenslander*. (179) It is clear that he arranged practical demonstrations and it may well be that these lectures were attended by the first apprentices from Barton, White and Co. After 1892 the newspaper reports of Barton's lectures were irregular. As examples, the opening lecture in 1894 and the 22nd lecture in 1895 were mentioned. Occasionally a detailed report was given, for instance a lecture on Duplex Telegraphy attracted attention in 1900 as did one in the Heat section of the Physics course about the same time. This resulted in the Stirling boiler being fully described with diagrams in the daily Press. (180)

Earlier than this there were indications of reorganisation of technical classes, for example mention is made of Departments within the Technical College and in 1894/5 the subject Electricity was included among courses listed by the Department of Science and Construction. (181) Later this was changed to the Department of Science, Engineering and Trades.

Thus the courses developed over the next decade by which time Barton was lecturing, giving tutorials and supervising laboratory classes for two to three evenings per week. In addition he took day (including Saturday) classes in Practical Physics. The electrical subjects expanded and in 1898 there were three stages listed, presumably corresponding to three years. (182) A list prepared by Barton in about 1896 (Fig. 83) shows the programme for two electrical subjects taken by him and lists a range of topics included in the courses. (183) At least by 1898 there was an ordered course of study leading to a Diploma in Electrical Engineering and as far as is known this was a pioneer step which was followed by the introduction of a University of Queensland Diploma in Engineering (Mechanical and Electrical) course in 1910.

Barton concluded his Technical College teaching work at the end of 1904 and in 1905 W. Arundell took over the electrical subjects.

Barton's lecture programme demonstrated his versatility and ability to keep up to date with new developments. As an example, he interested himself in wireless telegraphy at an early stage in its commercial development. In May 1901 his first lecture to his Brisbane Technical College class was entitled 'The Newest Developments of Marconi's Wireless Telegraphy'. The demonstration apparatus was operated by W.M.E. L'Estrange.

A similar lecture with the title 'Marconi versus the Cables' was given in March 1902 and the following press report leaves little doubt that Barton had unusual gifts in presenting new ideas in a form that could be readily understood by his audience.

> The lecture was intensely interesting from start to finish, and this was in no small degree due to the lecturer's carefulness in eschewing incomprehensible technical terms, his liberal use of diagrams, and his extremely helpful experiments. At the outset, Mr Barton successfully demonstrated the reality of Marconi's discoveries, and the discoveries of those experimentalists who went before him, by showing an apparatus, built by himself on the Marconi system, in full working order. The concise explanation of the apparatus that followed was easily understood by all. Mr Barton then explained the developments in the researches of other men that made it possible for Marconi to build up his system of wireless telegraphy, concluding by discussing the commercial possibilities of the new system as against the present development of the [submarine] cable. For one thing, the Marconi system was too slow — thirty-two letters per minute was its limit, while a cable 3000 miles long could carry 600 letters per minute. Beside this, Marconi had also to face the difficulty that an enemy could set up an apparatus which would make his messages unintelligible. ... (184)

It is interesting to find that Mr J. Hesketh,

Chief Electrical Engineer, Post and Telegraph Department, Queensland, when giving a University Extension lecture on 'wireless telegraphy' and 'telephony' in Brisbane some eighteen months later, clearly did not believe that wireless telegraphy would replace expensive cables and land lines although he added that 'anything was possible nowadays.' (185) Neither Barton nor Hesketh could have foreseen the rapid improvements in wireless telegraphy systems or, within the decade, the first use of wireless telephony (or radio as it became known).

The Brisbane Technical College Incorporation Act: While Barton was continuing with his lectures the first measure of Government control was introduced with the passing of the Brisbane Technical College Incorporation Act of 1898. (186) Under this Act a Council was formed comprising six Government representatives, three representatives elected by subscribers (presumably donors) and three by certificate students. J.W. Sutton, who had been Chairman of the School of Arts, Technical College sub-Committee for several years, was elected President in 1900. (187) Barton was a member of the Council in 1904 and was elected President in August 1904, continuing as a Council member until 1907.

As a further development a Board of Technical Education was formed in 1902 but disagreements brought about its abolition by the Government in 1905 and the responsibilities passed to the Department of Public Instruction under an Inspector. (186,188) In 1907 the Technical Instruction Act led to the formation of the Central Technical College and the Council was dissolved.

Accommodation for the large number of Technical College students was an increasing problem as new courses developed and in 1899 a new building was provided opposite the School of Arts building. It was noted at the time that –

> there were new classrooms for teaching Physics and that students could carry out their experiments from the simplest to the most complicated electrical construction. (189)

This was no doubt due to Barton's influence and was a most important educational development. The fact that it had to be pioneered is only too easily forgotten.

In 1914 the Central Technical College classes were moved from the Ann St building to one in George St adjacent to the then University of Queensland site where it was re-equipped and reorganised. The engineering Diploma work just referred to was carried out in co-ordination with the Faculty of Engineering of the University. University staff were appointed as College examiners and the four year course was given University recognition. Thus Barton — now a member of the University Senate — had the well deserved satisfaction of seeing the result of his long sustained contribution to technical education.

Apprenticeship: Implicit in the new mechanical and electrical diploma course and indeed in the earliest courses under the School of Arts was the corresponding apprenticeship training and Barton had definite views about this. F.R. L'Estrange, himself an apprentice to Barton's firm from 1904, made the following comments (33) in his recollections of the times —

> Mr Barton adopted a policy of indenturing apprentices; he was throughout the years to be a strong advocate of technical and practical training in the Technical College in addition to what was picked up from the men with whom the lads worked. Up to October 1898, apprentices were appointed on the payment of £200 and wages were just pocket money. After this time no premium was taken and the pocket money was halved — for a week of 45 hours, Saturday morning included. [With no premium, the weekly wages were as follows: first year, 1/3; second year, 1/9; third year, 3/9; fourth year, 5/–; fifth year, 7/6.] Mr Barton firmly believed that when a lad had completed his five years apprenticeship, he should be discharged within six months to gain additional experience. His colleagues in the Board Room, knowing that competition in the contracting field was becoming stronger, conceived the idea of countering Mr Barton's beliefs without exhibiting their disapproval for the reason that the BESCo, and later the City Electric Light Co., made a worthwhile profit out of contracting and repair work. In order to encourage employees to remain, shares were offered to all employees, old and young. The shares were first offered in September 1907 and the terms of interest were most attractive.

Elsewhere L'Estrange explained the arrangement. One pound shares were offered on the basis of 100 for each pound received as wages per week, the conditions being that the employee pay monthly calls amounting over five years to 13/4 per share. The City Electric Light Co. Ltd made up the remaining 6/8 at the end of the five year period. (190)

Barton's Views on Secondary and Technical Education: Barton took a broad interest in the

Queensland education system although understandably he was particularly concerned with technical education. The following newspaper articles, the first published in 1894 relating to secondary school work and the second — a report of an ANZAAS paper — in 1909 referring to apprenticeship training give his assessments at these times.

In the 1894 article, he raised 'the question of useful versus useless subjects in our schools' thus —

> Of the latter (useless subjects) I shall only discuss English grammar and music. I put the grammar first because music is not so objectionable as grammar, with its allied subjects of parsing and composition. English grammar is as unfortunate as Greek grammar. The one was created by our Dr Johnson and the other by Erasmus. How many of us have diligently learnt our myriad of tenses, moods created by the fertile brain of Erasmus for the purpose of symmetry, and when we came to Homer and Xenophon, we were coolly informed by our teacher that we were in the Doric or Attic dialect, and that all the verbs were irregular.
>
> English grammar is equally useless. It never taught a boy to speak correctly, because correctness of speech can only be acquired by practice and association with educated persons, i.e. persons who have become familiar with the language as fixed by the writings of our best authors. A man who really spoke grammatically would be called a prig. It would be a valuable accession to our knowledge to have a complete list of subjects and the hours devoted to each in our principal schools. The public could then judge whether any time or money could be devoted to the acquirement of manual dexterity, by curtailing the useless subjects.
>
> What we want is to make our boys bright and eager to learn. Dinning lessons into a sullen boy for a week is not as effectual as awakening his interest in the same subject for an hour, and the most astonishing result of the 'Slojd' (pronounced Sloyd) system in Scandinavia has been the increased 'appetite' for literary knowledge among the boys.
>
> The slojd system is apt to run wild like the literary system but in its proper elementary stage as suited to elementary schools it consists in training the eye and the hand by the shaping of soft materials into geometrical and common useful forms. For this purpose wood is generally chosen because it is cheap and clean in working. Clay is superior in some respects, but is objectionably dirty. In the smallest and poorest schools every scholar has to provide himself with a sharp pocket knife and during one or two hours every day he is taught to produce little square rulers, cubes, triangles, inkstands, penhandles, round rulers, teetotems for spinning and other articles the material being soft deal or beech. In the larger schools the highest classes have a workshop and benches, the cost of which is insignificant; in fact, the material is frequently given by a timber merchant and the boys make the benches, the tools being supplied by the school authorities. ... All we want is to give the boys the 'cunning of the hand' and then let them apply that cunning to a trade when they go to their apprenticeship. ... I look to the introduction of drawing as being the most important as well as the least expensive step. When drawing is introduced (say at the expense of that bête noir 'parsing') let it be with chalks on cheap paper instead of fine pencils on drawing paper or drawing books, where the boy is afraid of every line and rubs it out with the ever present eraser as soon as he has drawn it. Let him stand up and have his paper tacked on a vertical board and draw large. When drawing is firmly established the rest of slojd will follow. (191)

Some fifteen years later Barton, now an MLA, addressed an ANZAAS Conference held in Brisbane, on 'Aspects of Technical Education from a Queensland Point of View'. In introducing the subject he referred to his 'lengthy experience in connection with the [Brisbane] Technical College both as a teacher and as a member of the Council.' The paper expressed the view that the established form of apprenticeship training had broken down under machine shop methods and offered advice on the pattern of training that should be followed in these circumstances.

The newspaper report (192) summarised the presentation thus —

> After explaining that his paper would necessarily reflect the opinions of an engineer, Mr Barton went on to give an historical sketch of the industrial conditions of the last two centuries in so far as they affected the teaching of skill and handicraft showing how the apprenticeship system had gradually fallen to a very low state of efficiency owing to the advent of special machine tools thereby lessening the opportunities of acquiring and lowering the value of skill. In Europe and America this change in industrial conditions had brought into existence the 'machinist', who with a special machine could execute such work as a 'key seat' in less time than the skilled fitter of a former generation would need to 'mark out' the work. Many attempts, he said, had been made in England by employers ... to re-establish the apprenticeship system, but as the special machine gained ground, it became a more hopeless undertaking. Even in Germany, where trade schools were such a success in the seventies, the complaint now arose that young men would not attend classes, owing to the want of market for special skill. Unsuccessful attempts had also been made to re-establish the supremacy of

skill over the machine, notably the great strike of the Amalgamated Society of Engineers in 1897. In Queensland, where far more work was to be done in erecting and using machinery than in making it, there was little demand for special skill, but, owing to the scattered nature of settlement, there was more demand for general skill and intelligent understanding of machinery, and the author contended that, in addition to the present provision for special training in the theory of special branches of industrial work, our technical schools should provide for teaching general skill, using woodwork as the chief means for giving a command over the muscles of the hand, and training the eye to judge accurately of dimensions, plane surfaces, and angles, while training the mind to understand and interpret drawings. A certain amount of work with metals would follow, as every student training for industrial pursuits should not only acquire skill in woodwork, but should be familiar with such processes as soldering, rough filing, pipe screwing &c. He should learn rough mechanical drawing, and have a clear understanding of the drawings put before him. Such a training would, on his entrance into a workshop, go far to make a student from college more acceptable to foremen and more valuable to employers, saving him from much of the menial work usually given to novices. The preparation of the lad in the primary school was also dealt with, and it was pointed out that the teaching of arithmetic, which was at present specially suitable for the lad with a mercantile future, could with advantage be modified. The practice of aiming at absolute figure accuracy should be abandoned in favour of a percentage accuracy, rough approximations, with an error below 2 per cent being much preferable to long, tedious calculations, which are apt to obscure the process of reasoning and produce absurd results.

Eighty years later, the views expressed in the last sentence remain valid and all too familiar to those engaged in teaching.

THE UNIVERSITY OF QUEENSLAND: Barton was closely involved with establishment of the University of Queensland. In 1901, as Vice-President of the Queensland Institute of Engineers, he gave an Inaugural Address with the title 'Theory and Practice'. This referred to the need for improving present methods of educating the younger generation of engineers and he reminded the audience that a Bill for the incorporation of a University of Queensland had been prepared, as follows —

> While it was apparent that the Government contemplated the institution of a modern University and wished to make it more Scientific than Classical, yet the Bill was unfortunately drafted on the lines of the old charters of such Universities as Sydney. Under the older systems the management is vested in a body of men who are continuously recruited from within the University, whereby an intense conservatism is engendered. It is therefore highly desirable that the more modern method of Government as adopted in the case of London University and Birmingham University should obtain here. In these cases the control of the University is vested in a Senate recruited partly from the alliance but chiefly from recognised scientific, industrial and commercial associations.

FIG. 84. Edward Barton was appointed by the Queensland Government as a member of the first Senate of the University of Queensland in 1910. He served on various committees of the Senate until November 1915.

At a University Conference held in Brisbane in November 1906, Barton represented the Brisbane Technical College and gave a paper entitled 'The Influence of the University on the Standards of Primary and Secondary Education'. He expressed the need for the new University to be a modern organisation which 'would render it free from the narrowing influences of the too rigorous adhesion to the traditions of the past while at the same time

maintaining the scholarly influence of a true University.' (193)

On 10 December 1909 the Governor of Queensland gave assent to the University of Queensland Bill and E.G.C. Barton, MIEE (Fig. 84) was one of the twenty men appointed on 14 April 1910 as Senate members. As far as is known he was the only practising engineer appointed.

The University of Queensland Senate records show that in 1911 Barton was appointed Chairman of the Building and Site Committee which was mainly concerned with the conversion of Government House (at the end of George St) to University purposes and the procurement of equipment immediately needed. Among other matters the Committee considered the co-ordination of the requirements of the University and the Central Technical College to prevent duplication of laboratory facilities.

Later in the same year Barton was given leave to visit Europe and America and was appointed to represent the Senate at the 500th anniversary celebrations of St Andrew's, Scotland. The first Professor of Engineering — Professor A.J. Gibson — had also been given leave about the same time to travel overseas to acquire laboratory equipment for the Engineering School so it is very likely that Barton took part in the enquiries since the items included hydraulic plant, heat engines, material testing machines and electrical apparatus. (194)

In January 1912 Barton was welcomed back to Brisbane and in April he was appointed Chairman of a Senate Committee set up to deal with Public Music Examinations under a joint scheme with other Australian Univerities. By early 1913 Barton had been appointed to the Education Committee and the Library Committee of the Senate while continuing to chair the Buildings and Grounds Committee (newly named) and the Music Committee, previously described as the Musical Committee. Barton's interest in a scheme of music examination was noted by Percy Brier, a well-known music teacher in Brisbane who, in referring to the establishment of the Australian Music Examinations Board in Queensland, credited this interest thus —

> that honour belongs to an amateur — E.G.C. Barton — an engineer who was, I believe, a member of the University Senate. He tried to interest me in the scheme before the outbreak of World War I but I was not interested until 1922 ... (195)

Barton again applied for leave of absence from May 1913 until the end of the year and on this account relinquished his chairmanship of the Buildings and Grounds Committee. The period of leave seems to have been extended to July 1914 and he then resumed his other Committee activities until November 1915 when he was granted leave to visit England. What his plans were at this time are not known but it seems clear that he wished to assist in the war effort in Great Britain. Possibly this was the time when he presented books and periodicals to the Library of the University of Queensland Engineering School.

He is listed in the Roll of Service of the University of Queensland under 'Munitions Workers'. (194) Another contemporary record describes his war service thus: 'Inspector of H.M. Factories, Department of Munitions; (later) Assistant to Professor J.A. Fleming.'; an obituary (1943) stated that 'he served in 1915–16 in the Department of Munitions (High Explosives), and later in the Naval Information Department.' The obituary stated that he spoke French, German and Italian; probably his fluency in German acquired as a student in Germany, would be relevant to the last appointment. (7,8) By the time he returned to Brisbane in June 1920 the life of the First Senate was over.

Professional Engineering Societies

THE QUEENSLAND INSTITUTE OF MECHANICAL ENGINEERS: From the earliest days of the Australian Colonies, membership of one of the English-based professional institutions of engineers was not only the most usual recognition of adequate professional ability but such membership, giving access to the publications of the institution concerned, enabled engineers to keep abreast of professional practice. Long before there was the possibility of world-wide recognition of an Australian based engineering institution, the desire to have a means of sharing professional experience was evident and thus were formed specialist associations such as the Mechanical Engineers Association in Queensland which was formed in 1886. (196) Nothing has been found about its activities but evidently it was succeeded by the Queensland Institute of Mechanical Engineers shortly before September 1890, with C.A. Bernays as Secretary. (197) Soon afterwards there was an enrolment of forty members, (198) the first Committee being

elected in December, and this included Barton.

The first lecture to the Institute was given by Barton early in 1891 on the subject 'Electrical Engineering' and his next lecture, given in October 1891 was on 'The Phonograph'. This included a demonstration of a newly acquired Edison cylinder type machine which was battery operated. The lecture was fully reported, with many diagrams prepared by Barton, in a trade publication. (199)

In 1893 he gave a lecture on 'Elementary Manual Instruction' expressing similar views to those mentioned earlier. The lecture was reported at length in the *Queenslander* of 29 July.

The Institute was most progressive in offering prizes for the best papers — one to a member and one to a student. This was in 1892 and was followed in 1893 with the offer of awards for mechanical engineering apprentices based on the results of examinations set by the Institute. (200,201) Barton was elected to the Institute Council in 1894 and as Vice President for 1894–5. (202) It is not known when the Institute concluded its activities but by 1905 funds amounting to about £50 were transferred to the Queensland Institute of Engineers to be added to the Sir Thomas McIlwraith Scholarship fund for final year engineering students at the University of Queensland. (203)

THE QUEENSLAND ELECTRICAL ASSOCIATION AND THE QUEENSLAND INSTITUTE OF ENGINEERS: Barton may be assumed to have had a major part, with J. Hesketh, in founding the Queensland Electrical Association in 1898. (204) The idea was not a new one in Australia as an association of electrical engineers was first proposed in 1891 when a small group formed an Electrical Club in Sydney, N.S.W. They organised social evenings and held regular meetings at which papers were given. The name was changed to the Electrical Association of NSW in 1896. (43)

The main object of the Queensland Association was stated to be —

> To promote the general advancement of Electrical and Telegraphic Science and its applications, and to facilitate the exchange of information and ideas on these subjects amongst the members of the Association and otherwise ..

There are details about holding meetings, promoting exhibitions, publications, and the formation of a library. In the inaugural Presidential Address, Hesketh remarked that —

> the Association should form the centre of a healthy, vigorous, and militant body of engineers — engineers in heart and action, if not always in name — intent on putting Queensland in the advance guard of the Colonies with regard to electricity in all its branches. (204)

Barton was elected President in 1899 (205) and between 1898 and 1907 gave at least seven papers (listed in Appendix E) to the Association on a wide variety of subjects. One of the most interesting, given in 1901, advocated polyphase supply for electric railways instead of the conventional direct current. A proposal was outlined for south east Queensland. Electric railways came some eighty years later but by then single phase high-voltage alternating current was the obvious choice.

Barton's versatility is illustrated by his detailed paper in 1901 based on his experiments with a Morse sounder — a basic piece of equipment in the electric telegraph system at that time. His reason for the study is explained in his reply to the discussion following the lecture —

> I am very pleased with the reception recorded to my paper, and the opposition shown in the discussion has fully rewarded me for venturing out of my own domain into that of Telegraphy. I may say that I was induced to make the venture because the great majority of our papers have been of the type described by the Germans as 'starkstrom' (heavy current) and have naturally led to a lack of interest on the part of the 'schwachstrom' (light current) man. In going so far out of my own domain I did not wish to attempt too much, and have therefore selected the sounder. On reading up the subject I was astonished to find that the Telegraph people had not wakened up to the use of the modern electrical units, that the old ideas of ohms and Daniell's cells still reigned supreme, and that the modern concepts of henries, magnetic flux, and ampere turns had not spread among them; even the words volt and ampere had not come into general use among them. Looking at the matter from the point of view of one who has been reared in an atmosphere of electrical measurement, I felt that the most important conception in telegraphy was that of self induction, or, as it is sometimes called in heavy current working, back E.M.F. or counter E.M.F. After coming to this conclusion I found that study of the action of the sounder presented considerable difficulties in spite of its apparent simplicity.

He began his paper with the following amusing implied criticism of a tenet of light current engineers of the period —

> Old beliefs are hard to kill, and although

> electricity is a young science there is one saying which amounts to a belief with many, and which has given rise to much trouble in the past; I refer to that well-worn expression 'The external resistance shall equal the internal resistance', whereby is usually meant that the resistance of the electric circuit outside the generating apparatus should be equal to the resistance encountered by the current in passing through the generating apparatus itself.
>
> Many years ago I was running an electric light plant, and a kind-hearted old gentleman, with the best of intentions, came and explained to me that my whole difficulty lay in equalizing the external and internal resistance, and when I informed him that the internal resistance of the dynamo was a fraction of an ohm, and that lowering the external resistance to the same would result in a red-hot armature, he smiled incredulously and left me. (206)

In October 1901 the Association formed a committee to consider the clauses of the Electric Light and Power Act of 1896, to suggest improvements and report to the next meeting of its members with a view to laying proposals before the Minister. (207) Problems which the Act created have been referred to above and no doubt these were strongly presented. The outcome of the 1901 discussions is not known, but in 1909 the subject was still alive and a deputation from the Association waited on the Minister for Works. (155)

The Queensland Institute of Engineers was formed in 1901. This had been discussed in 1900 and at a meeting of interested engineers in September Barton was voted to the chair presumably in recognition of his support for the proposal. (208) The objects of the new Institute were:

(a) to promote the science and practices of engineering in all its branches and to give an impulse to inventions likely to be useful to members of the Institute and to the community at large.

(b) to enable Engineers to meet and to correspond and to facilitate the interchange of ideas respecting improvements in the various branches of engineering science, and the publication and communication of information on such subjects.

The first formal meeting was held in April 1901 when Barton as Vice President gave the inaugural address, in the absence of the President. (209) Barton was President for 1901–2 and 1903–4 and again Vice President for 1915. He contributed at least nine papers to the Institute on a wide variety of topics. (Appendix E)

In 1905 the Queensland Electrical Association and the Queensland Institute of Engineers gave a farewell dinner to Barton and his wife before they left for overseas. There were many references to his career and the following are extracts from a newspaper report of the occasion —

> Mr Barton had the distinction of having introduced the steam turbine to Queensland ... At the time he was working up his business he did not neglect experimental work and his labours in connection with magnetic separators would not be soon forgotten. He has really been responsible for the resuscitation of their Engineers' Society [QIE].

Referring to Barton's interest in technical education, one speaker remarked —

> Their guest had the happy gift of explaining the use of technical subjects and in consequence was a very successful teacher. (210)

His address to the Institute in October 1906 entitled 'A Voyage of Discovery in the Workshops of Europe' would have been fascinating but unfortunately no copy has been found and it only rated a few lines in the Press. (211)

In May 1907 Barton addressed the Opening Session of the Association on the subject 'Electricity in the Service of Women' — the title no doubt chosen in contrast to that of a standard text book of the time, 'Electricity in the Service of Man'. He recognised that help with household tasks by the employment of servants would cease and that the housewife would need electrical appliances to compensate for the loss of such help. He cited the advantages of the electric stove, the electric iron and electric lighting over the gas equivalents. The electric fan, the electric bed warmer and a refrigerator powered by an electric motor were also listed as desirable.

The leisure resulting from the adoption of electricity in this way would enable the lady of the house to visit her friends in an electric car which would have a range of about 30 miles at a speed of 15 miles per hour. His predictions concluded with a list of applications in the home and he indicated how long each device would operate for the cost of two pence, the expected future price of an electrical unit of energy. (212)

In October 1909, Barton gave a paper entitled 'The Status of Engineers and the Affiliation of Engineering Societies throughout Australia.' This is the first reference found in the minutes of the Queensland Institute of Engineers to such a development. The *Brisbane*

Courier of 1 November 1909 reported that —

> Mr Barton read a short paper on the status of engineers in Australia, and the efforts being made to affiliate the several societies in the different States, so that their local knowledge should command the attention due to it. The Council had already taken action, and now awaited communications from kindred societies in other States.

In spite of this early initiative, progress was evidently slow as the next reference to a 'proposed Australian Institution of Engineers' was in the minutes of a QIE Council meeting held on 24 June 1914 at which, incidentally, Barton was welcomed after an overseas visit. The minutes of the January 1918 Council meeting show that a national body was under discussion; this was instituted in the following year as will be referred to shortly.

To illustrate the breadth of Barton's interests, in 1909 he led a deputation representing the Queensland Institute of Engineers to the Minister for Public Works with reference to the provisions of the Metropolitan Water and Sewerage Act. The Bill was still before the Legislative Council and QIE members were concerned that with the likely composition of the Water Supply and Sewerage Board, there was the possibility of the technical men being overruled by non-technical interests. Barton expressed his concern at references in the Press to importation of men with the necessary skill to do the work entailed by the Act as he considered that these positions should be made available to young Queenslanders. There were discussions about ventilating shafts and the basis for charging for the new services. Barton argued that rating on floor space rather than maximum demand was very unfair. (213)

In June 1910 Barton was appointed to represent the QIE at a conference of the Australian Institute of Mining Engineers held at Mt Morgan, near Rockhampton.

THE INSTITUTION OF ENGINEERS, AUSTRALIA: In 1911 the Queensland Electrical Association merged with the Queensland Institute of Engineers; members of both organisations elected representatives on the Committee of the Institute at the time.

Several years later the QIE agreed to join with similar Institutes in other States of Australia to form the Institution of Engineers, Australia. (196) Barton became one of the 128 Associate Members from the Brisbane Division of the new body although he was living in England at the time. (214) He evidently retained his interest in professional society activities and during a visit to Brisbane in 1922 gave two lectures to the Brisbane Division members. (Appendix E)

The International Conference on Large Extra High Tension Systems met in Paris in June 1925 and it is very likely that Barton attended this because the Faculty of Engineering, University of Queensland had recommended to the Queensland Committee of the Institution of Electrical Engineers, London that he be invited to represent Queensland. (215)

In 1926 he and Ernest Bate of the State Electricity Commission of Victoria represented the Institution of Engineers, Australia at the Centenary of the Incorporation by Royal Charter of the Institution of Civil Engineers, London. The representatives were referred to as 'one from the older, and one from the younger generation of distinguished Australian Engineers.' (196)

Barton's interest in the Institution of Electrical Engineers, London is evidenced by the fact that in 1896 he was elected an Associate of that Institution and in 1899 became a Member. Up to 1907 the Institution had been represented in Queensland by engineers employed by the State Department of Post and Telegraph, or later by those of the Postmaster General's Department. Barton received the IEE appointment in 1907 with the designation of Local Honorary Secretary and Treasurer. He relinquished this position in 1915 when he left for England to take up war work there. (216)

Overall Barton's contribution to the formation and development of professional engineering societies was exceptional. He held office in three such Queensland societies and gave at least 23 papers on a variety of topics, principally in the fields of electrical and mechanical engineering.

COMMUNITY SERVICES AND SPECIAL INTERESTS — EARLY 1900's TO 1942

QUEENSLAND PARLIAMENT, 1908 TO 1909

In February 1908 Edward Barton was elected MLA for North Brisbane representing the Kidson Socialist Party in the capacity of Junior Member in the Seventeenth Parliament with an annual salary of £300. (217) Bernays, referring to his appointment, described him as —

> the man who originated and stuck to the now prosperous City Electric Light Co. (218)

His motivation for entry into political life can only be guessed from the records of Parliamentary Debates of the time. (219) Perhaps he was influenced by early recollections of his father's political experience and an inherited interest in socialism. There could have been a conflict in philosophies since he was Managing Director of a strongly free enterprise organisation.

The political situation was an unusual one. On 22 November 1907, the Sixteenth Parliament had been dissolved after a life of only several months and, in the Seventeenth Parliament, Premier Kidson often had an extremely small majority when legislation was being passed. Yet Bernays (218) while discussing the times as 'one of the tensest periods in our Parliamentary history' added that —

> few sessions of [the Seventeenth] Parliament have produced measures fraught with so much importance.

So it must be concluded that there was a challenge for Barton to spread his influence into politics.

Barton made his first speech in Parliament in March (219) and later took part in discussions such as the need for pressing on with the University Act, developing technical education by the awarding of scholarships and the setting up of a Teachers Training College. The Session ended in late April and Barton was presumably given leave from his Parliamentary duties for several months as he was in Europe for the period May to October 1908. He is recorded as attending an official dinner in London on 25 June in his capacity as an MLA. (220)

The Second Session began on 17 November of the same year and Barton spoke at length against a proposed amendment to the Address-in-Reply. (221) This amendment was in effect a vote of no confidence in the Government. Bernays has summarised the main features of the proceedings which included attempts to abolish, or at least reduce, the powers of the Legislative Council. By August 1909 the Government had a working majority of one and was dissolved; this and the two preceding Parliaments had lasted a total of five years. (218)

Barton had taken little part in the Third Session and did not contest the North Brisbane seat at the next election, late in 1909, so that his period of Parliamentary service was from 5 February 1908 to 2 October 1909. As stated earlier he resigned as Managing Director of the City Electric Light Co. Ltd in June 1909 to practise as a Consulting Engineer. He subsequently became a Justice of the Peace.

Although not directly connected with the Government it is convenient to note here that Barton took a prominent part in a benevolent organisation, the Brisbane Institute of Social Service and was President from about 1910 to 1915, after which he remained a Vice President for some years although living overseas. (222)

Scientific Societies

Barton was a member of several learned societies in addition to those directly concerned with engineering. There are others to which he is believed to have belonged but his memberships have not been confirmed for lack of local records.

Membership of the Royal Society of Queensland was recorded in his application for Fellowship of the Royal Geographical Society, London. (223) However the RSQ records of the time do not list members and no relevant contributions by Barton have been found. Another society mentioned by him, the Royal Meteorological Society of Queensland has not been traced so the basis of his claim to membership in 1914 cannot be discovered. (223) A Meteorological Society of Australia was formed by Clement Wragge in Adelaide in 1886 before he came to Queensland as Government Meteorologist, so a Queensland branch may have been formed about this time — without a Royal Charter! (224)

However, his interest in meteorology is evident from his election as Fellow of the Royal Meteorological Society, London in June 1909 although he did not publish in the Society's Journal.

There is no doubt that Barton was a foundation member of the Historical Society of Queensland when it was formed in 1913, and was a member of the Provisional Committee. As he was only briefly in Brisbane after this date it is not surprising that no papers by him are recorded.

Of the Queensland scientific societies, he appears to have shown the greatest interest in the Royal Geographical Society of Australasia of which a branch was formed in Queensland in 1885. He became a member in 1902 and served on the Council of the branch in 1908/9 and 1909/10.

In 1906, Barton gave an illustrated talk to the Queensland Branch entitled 'Central Europe

Revisited' describing his 1905 visit, the first since he left Europe to return to New Zealand 23 years earlier. (225) The International Geographical Conference was held in Geneva in July 1908 and Barton was appointed to represent the Queensland Branch of the Royal Geographical Society of Australasia. His extensive report is a wide ranging account of his experiences both at the Conference and during his travels in other parts of Europe about this time. He commented that —

> The real object of a Congress is to give an opportunity to the men of science of bringing before the World an account of the most recent steps in their special studies. By this means is secured that frequent interchange of thought which lies at the root of the rapid progress made by science during the last twenty years, compared with the previous century. The reader of a paper not only gains publicity, but also has the benefit of so putting his communication on record that no rival can afterwards claim the credit of his discovery — glory and renown being apparently the goal of the enthusiasts who frequent such congresses. ... I may say at once, that to me, coming from the other end of the earth the most attractive part of the proceedings lay in the opportunity of coming into contact with men whose names had been known to me for many years. To see these men and to have speech with them was indeed a great joy. To meet at the breakfast-table such men as Bartholomew, the map maker of Edinburgh ... and many others was quite an experience for me ... A striking feature of the Congress was the use of four languages — French, German, Italian and English, which were officially recognised. The first three ... were necessarily recognised by the Committee, but English was added because it was well known that the English speaker seldom learns foreign languages. (226)

A newspaper report added that each delegate spoke in his own language except the Russian delegates who spoke in any of the above four. (227) Barton is credited with fluency in French, German and Italian and hence would be able to participate fully in the proceedings. (7)

Barton had been asked on behalf of the Queensland Branch, and with the support of the Queensland Government, to invite the congress to hold its next meeting in Brisbane but as he remarked 'this was not seriously entertained but I had the consolation of seeing the invitations of twenty other towns meet the same fate.' He was however elected Vice President of the 'Rules and Nomenclature Section' of the organisation. A meeting of meteorologists in Hamburg was held about this time and Barton attended this and also a meeting of the British Association for the Advancement of Science in Dublin.

In April 1911, he read a paper to the Queensland Branch entitled 'Weather and Its Causes' — one of the longest of his published papers. It shows his wide-ranging interest in this subject and discusses exploration of the upper atmosphere with balloons. (228) Following his European visit in 1913–14, he gave an illustrated talk to the Branch entitled 'Some Cities of Europe, their Beauty as an Investment, their Traffic and Housing Problems'. This was illustrated with lantern slides. (229)

During a visit to Queensland in 1920 Barton gave an illustrated lecture to the Society on 'Old Europe in its new Garb' and, while on a second visit in 1922, he gave a talk on aerial mapping with the title 'Bird's Eye Mapping'. At about this time the Society bestowed on Barton the Diploma of Fellowship in recognition of his services to geographical science, thus permitting him to use the initials FRGSAQ.

In June 1914 he was elected a Fellow of the Royal Geographical Society, London; the Geographical Journal (the organ of the RGS) records several contributions to discussions for the period 1917 to 1939. One of these related to the inconvenience of using feet and fathoms, as he had done in his own work on estuaries and sandbanks; others related to colloids and delta formation and to tidal prediction. Details of his work in Australia have not been found but rough notes by the late F.R. L'Estrange suggest that as far back as 1904 Barton was studying the silting up of estuaries and the formation of sand dunes in the vicinity of Southport, Queensland. (230)

Barton had a keen interest in tidal phenomena and in February 1935 he had completed a cinematograph film, described as a 'Tides Film', for educational purposes. In his correspondence with the RGS (from his home in Watford, near London) he stated that the film included —

> a series of separate representations of tidal movements across each of the great oceans and a more detailed representation of the manner in which successive tides come from the Atlantic and sweep around Britain.

Much work was involved as he made —

> some 1500 maps each of which differs little from its predecessor so that no contour line shall appear to move more than half a millimetre ... this was a necessity imposed by the cinematograph ... after ten years on this tide film and three changes of

technique, I thought it best to face the public with my film. In any case a pioneer must face ridicule and, if he gets a few bits of intelligent criticism, he can commence all over again (if he is young enough. I am only 78 [sic] years old.)

Nothing further is known except a comment by the RGS in recent correspondence with the author that the 'film was not shown at the RGS.'

Other evidence of Barton's interest in this field comes from the following boyhood recollections of meeting Barton in 1915 or earlier (when the writer of these notes and his companion were about nine years old). These not only support the belief that Barton was studying coastal erosion at Southport, Queensland and vicinity but also provide an interesting sidelight on his personality.

> We were told that he was a very brilliant man and Mr Sinclair [the father of one of the boys] had been very impressed with his scientific knowledge and activity in scientific research. He asked Mr Barton if we could come along and meet him, and see some of the wonderful things that he had to show. We called on him at the Pacific Hotel [Southport] where he was staying, and so far from being overawed at meeting such an important man, we were put instantly at our ease, and it was obvious that he was delighted to show to anyone, young or old, the interesting equipment and specimens which he readily explained in simple terms which we were easily able to understand.
>
> It now [1986] seems a long time ago but I recall clearly that he produced a Pedometer, an instrument the size of a pocket watch, which he carried on his watch chain on the end which usually carried a metal case called a sovereign case in those times. In this instrument there was a balanced weight on a lever and it moved the lever up and down with each pace and no doubt he calculated distances on the formula that one normal pace equalled 30 inches, so 36 paces equalled 30 yards, after reading the dial which showed the number of paces from Point A to Point B. His equipment included a folding tripod and what must have been a theodolite. His private research at that time had something to do with fluctuations of the sand dunes, and he usually covered a distance of several miles per day.
>
> Mr Barton also had a microscope and we were greatly delighted to see what fish scales, butterfly wings and other things, looked like under magnification.
>
> As I remember him, Mr Barton was a fairly robust man of medium height and I think he had a small dark pointed beard which was quite common at the time. It was a memorable experience for us both and his genial and friendly nature made a deep impression on us. The man who brought Electricity Supply to Brisbane was naturally a very 'big' man, especially to youngsters like us. (231)

Decimal Association, England

The advantages of the decimal and metric systems over the Imperial System of currency and units of measurements would have been very well appreciated by Barton from his student days in Germany in the 1870s. Hence it is not surprising that he wanted English speaking countries to convert to the metric system. In 1911 he expressed the hope that the metric system of measurement would be introduced in Australia. (232) This interest, which had apparently received little encouragement in Queensland, blossomed in England and he became an enthusiastic member of the Decimal Association after World War I. The Association had been formed in 1892 in London and Barton began their publication 'The Decimal Educator' in 1918. (233) Following a farewell dinner in April 1920 in London when Barton was leaving for a visit to Australia, appreciation for his services to the Association was expressed thus —

> All old friends of Mr. E.C. Barton, and the many new ones that he made during his sojourn in this country, will learn with great regret that he has returned to Australia, to attend to his private affairs which he had so long left to look after themselves while he helped to win the war. None will feel the loss more keenly than the members of the DECIMAL ASSOCIATION, for he has been one of its staunchest supporters, a most active member of the Executive Committee, a fertile source of new ideas for propaganda purposes, and a lecturer on decimal coinage and the metric system of unexcelled interest and charm. Mr. Barton, a member of the Institution of Electrical Engineers, and a Fellow of the Royal Geographical Society, is no mere theorist or visionary; trained in this country as an electrical engineer, he was in charge of one of the early electrical undertakings here in 1881, and seven years later he started the first electricity works in Queensland, after which he built up a flourishing business in Brisbane. He filled many posts in the public service, being at one time Member of Parliament for the city of Brisbane, President of the Technical College Council, and a governor of the University. When war broke out he returned to England and placed his services at the disposal of the Government, being employed on various commissions of national importance. He never missed an opportunity of advancing the cause of decimal counting, and was the originator of the DECIMAL EDUCATOR. On behalf of the Decimal Association, he repeatedly toured the

country, and delivered some 70 lectures, besides carrying out invaluable work in organising public opinion on the subject of counting in tens. (233)

He returned to England by September 1921 and continued his interest in the Association as a member of its Council and in about 1935 was appointed President of a Committee set up by the International Chamber of Commerce 'to enquire into the question of the introduction of the metric system into all countries'. (223) He became Chairman of the Association in 1937 or earlier and continued in this position until his death in 1942. (7,234)

Publication of 'The Decimal Educator' ceased in 1936 and as there are no holdings in Australia it has not been feasible to compile details of Barton's contributions. However the following comment from Cambridge University Library shows his continuing interest —

> even a cursory glance [at the publication] shows that from about 1920 Barton contributed regularly and prolifically. Scarcely an issue was published without something from his pen; some have as many as three articles, letters or reviews by him. (235)

Overseas Travel

Barton's overseas visits to Europe occurred with increasing frequency during the early years of the twentieth century and most have already been referred to. He was away from Australia for at least some part of 1905, 1908, 1911, 1913–14, 1915. This information came from various archives and from a collection of postcards written by Barton and kindly made available by family connections living in Brisbane. The cards came from a variety of countries including England, France, Germany, Ireland and Switzerland.

He probably visited New Zealand from Australia a number of times either professionally or for family reasons as his father became a Judge of the Native Lands Court there and his brother, Elliott, was a Crown Prosecutor at Hawera (North Island). However only two references to trips to New Zealand — in 1906 and 1907 — have been found.

It seems likely that Barton lived in different European countries after 1915. The one photograph of this period shows him on skis in Switzerland in 1925 (Fig. 85). He attended the British Association for the Advancement of Science Conference in Bournemouth, England in 1919 and other Science Conferences in Europe.

Fig. 85. Edward Barton made Europe his home from 1916 until his death in 1942. He was an enthusiastic skier and a frequent visitor to Switzerland. The photograph is dated 1925.

Socially he was shown as a member of the Royal Societies Club, London in 1922–3. (8) The only definite residential address was in Watford, Hertfordshire where he lived from 1935 to the time of his death in 1942. (234)

An interview in Brisbane after his return in 1914 from a twelve months overseas visit covered topics as diverse as the advantages of decimal currency, town planning in European cities including the means of financing plans for beautification, electrical developments in Belgium and winter sports in Switzerland. (236)

A personal letter dated January 1928 from London gave his views on letter writing and he made the distinction between a correspondent and a letter-writer; he prided himself on being a good, but tardy example of the latter. As an illustration he enclosed several typed pages of a fascinating description of a bicycle tour which he had taken with a friend in the previous year through the Jura Mountains (on the French–Swiss border). He found historical and architectural interest in most towns and villages that they went through and mentioned many local legends of the countryside.

The London letter concluded with the remark 'I have a lathe in one of the hotel rooms where I work many hours without feeling tired.'

Barton's activities were extremely wide

ranging. He took an active part in scientific societies concerned with engineering both in Queensland, and overseas, maintaining this interest for many years together with his major responsibilities as head of an electricity supply company.

EPILOGUE

Barton was a man with great vision and versatility, yet at the same time quite unpretentious in character. He spent about thirty years of his life in Queensland and for most of this period led the quiet revolution during which community attitude towards electricity changed from opposition to rapidly increasing acceptance for both domestic and industrial use. He and his colleagues achieved this success with a rare combination of ability, enterprise and industry that would have discouraged a less dedicated group.

The hindrance to development was, of course, the high cost of small scale production of electrical energy in the 1890's. Electricity for lighting was far more expensive than gas and thus there was virtually no demand for ordinary domestic purposes. By the time there was some growth in demand for supply to industry and commerce (the former relating particularly to the use of electric motors) Australia suffered a widespread industrial depression greatly exacerbated in Brisbane by the disastrous floods in 1893.

The difficulties of the period 1893 to 1896, the year in which Barton and White became insolvent, and the steps in the formation of a new company are set out herein. The major achievement of obtaining promptly an Order in Council and thus legalising the giving of electricity supply paved the way for development without the threat of effective objections by the Brisbane Municipal Council. Nevertheless, financial problems were paramount owing to the small amount of industry using electricity. The next several years saw a gradual improvement in the situation to a point where proper capital investment was possible and the electricity supply industry could be regarded as firmly established.

Today the emphasis is on developments in new fields that could not have been even contemplated by the engineers of Barton's time. However, it is salutary to consider the progress in power system technology that was made in the last two decades of the nineteenth century in comparison with that achieved over the nearly ninety years of the present century. In the earlier period, changes in practice were occurring at a remarkable rate and Barton coped with these rapid changes as he did with the strong opposition to the introduction of electricity supply in Queensland. This objection was of course primarily for the economic reasons just mentioned but there were also powerful vested interests and local government politics to be contended with.

In 1889, Barton took the initiative in setting up and himself conducting classes in Electricity at the Brisbane Technical College which was part of the Brisbane School of Arts. This interest he continued with increasing responsibility until the end of 1904.

He also recognised the importance of professional engineering societies and took a leading part in their development. His lectures to these societies show that he belonged to an era when it was not unusual for leading professional engineers to have a range of knowledge extending to almost every aspect of the respective fields in which they were acknowledged experts. Soon afterwards specialist subdivisions developed so rapidly as to make this overall understanding virtually impossible.

Barton was a firm supporter of the idea of setting up a University of Queensland for at least ten years before it was founded and he served on the First Senate — the first engineer to be elected — in a variety of capacities. In addition to his technical ability he had an excellent command of English. If one adds the belief that he was fluent in three foreign languages the picture emerges of an unusually well educated man.

Little has been said about Barton's personality and his relationship with his associates and employees. Fortunately we have the recollections of a contemporary, albeit then junior, member of staff, Gilbert Mackenzie, which provide a picture from an employee's point of view —

> Mr Barton was a very active man, with a happy personality, which combined with his experience and leadership, were the main factors in the progress of the Company. The staff were indebted to him for his all-round knowledge of every department, which he freely imparted to them. He gave special lectures to the staff and helped to illustrate the subjects by lantern slides. He also gave public lectures which created great interest. I was called upon several times to operate the projector and slides for these functions. If any interruption occurred, Mr Barton was ever-ready with some funny remark that put the audience in a

> good humour ... He took a keen interest in sport, he being a good athlete, and he rode one of the first free-wheel bicycles in Brisbane ... (80)

Mackenzie also recalled an occasion when the Directors of the City Electric Light Co. Ltd provided a dinner for the contractors, their workmen and the employees of the company. This was to mark the opening of the Ann St power station in 1899 or early 1900 —

> It was held in the workshop ... and Mr Barton was in his element as Chairman. He proposed the toasts. He congratulated the Contractors, also the staff on a good job done. Mr Tom Hall, the builder, being too full for words, could not reply. To save him from any further embarrassment, Mr Barton replied for him in a very clever and humorous speech.

An overseas reference to his personality comes from the Decimal Association of England. His work with them was greatly appreciated and he was referred to as a lecturer on their behalf of 'unexcelled interest and charm.' (233)

Throughout the period of his work in Queensland up to about 1895, Barton received advice from both his father and mother who were living in New Zealand. This correspondence, preserved in SEQEB Historical Records, provides a fascinating study in human relationships; in the early years Barton's parents apparently considered themselves better informed or perhaps more realistic about the financial problems and business associations related to Barton's firm that was Barton himself.

No mention has been made of Barton's family life in this biography. However, it should be stated that there was one child of his marriage with Mary Allan Sutton of Brisbane, Joseph George Elliott Barton, born in Melbourne in 1897. (237) Mary Barton predeceased her husband in 1935 in France.

After 1915, Barton's relationship with the electricity supply industry in Queensland was probably limited mainly to his interest as a Director of the City Electric Light Co. Ltd until March 1918 and of the Ipswich Electric Supply Co. Ltd until 1925. He continued as a Consultant to the former Company until 1923. After 1916 his main interests appear to have been in Europe but none are believed to be related to the electricity supply industry there.

After some twenty years of living on the Continent and in England, Barton made his home in Watford, Hertfordshire. He was residing at 29, The Ridgeway at the time of his death on 15 June 1942, aged 83. There is no evidence of his holding any public office in Watford and there was apparently no obituary in the local newspaper. (234) The records of the Golders Green Crematorium, London show that his remains were cremated on 19 June 1942 and his ashes scattered in the Garden of Remembrance, on the crocus lawn. The provisions of his Will included small bequests to the Decimal Association, London and the University of Queensland. Surprisingly, he left the sum of £25 to his ex-partner, C.F. White, 'as a small reminder of our association together.' (238) White's shortcomings of 50 years before were evidently forgiven!

A Brisbane newspaper reported his death several days later but the reference to his career was brief and inaccurate, the only electrical engineering work mentioned being that carried out at Thargomindah in the 1890's. (239) Later the Institution of Electrical Engineers, London outlined his career in an obituary. (7)

Barton had the distinction of being an Australian-born engineer entrusted with the supervision for some months of the earliest development of commercial electricity supply in England and several years later of being personally responsible for the equivalent development in Queensland. Thus he has been aptly described as the 'father of the electricity supply industry' here. There is no doubt that from his enterprise, perseverence and leadership has evolved the whole discipline of the present large scale electricity supply networks in this State with the resulting benefits to the entire population.

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Help has been received from many quarters both in Australia and overseas in the preparation of this biography; this is gratefully acknowledged although it is impractical to list all sources. However, the author is particularly indebted to the South East Queensland Electricity Board for allowing him access to the extensive historical records relating to the development of the electricity supply industry and for giving permission for extracts and illustrations from these to be reproduced. Special thanks are due to Mr Ray Brown, a staff member, for his assistance with searches.

Permission for the reproduction of illustrations from the Alexander Turnbull Library, New Zealand, the Science Museum, London, the Queensland Museum, the Queensland Government Railways and Messrs. Babcock International plc is acknowledged with

the author's thanks as is the use of information supplied by Babcock Australia Ltd.

REFERENCES

1. Whitmore R.L. (ed). *Eminent Queensland Engineers*. Institution of Engineers, Australia, Queensland Division, Brisbane, 1984.
2. Prentice S.A. *et al.*, 1985. Nineteenth Century Queensland Engineers: E.G.C. Barton, A.J. Goldsmith, W.D. Nisbet. *Institution of Engineers, Australia, Queensland Division Technical Papers*, Vol. 26, No. 18.
3. Summary of additional information about George Elliott Barton (1825–1903) from Scholefield, G.H., 1940. *A Dictionary of New Zealand Biography*, Department of Internal Affairs, New Zealand and *The Cyclopedia of New Zealand, 1897*.

   G.E. Barton was a member of the Provincial Council for the City of Dunedin in 1871 but was defeated in 1873. In 1874 he unsuccessfully contested a Dunedin seat in Parliament and in 1876 moved to Wellington to enter into practice with H.S. Fitzherbert.

   The most remarkable event in his career happened while practising as a Barrister in Wellington in 1878. While pleading in a case before the Chief Justice he was involved in an argument as to costs, found guilty of contempt of court and fined £50 which he refused to pay. However it was found next day that the proceedings of the Court had been illegal.

   On the same day while acting as counsel for a client he characterised its judgement as unintelligible and proceeded to argue with the bench; he was four times ordered to sit down and hold his tongue but continued to remonstrate and was then sentenced to one month's imprisonment in Wellington gaol. While incarcerated there an election for Parliament was held and Barton — described as a 'pronounced democrat' — was the successful candidate. When the result was known 'a vast concourse of people went up to the gaol and cheered the new member who appeared at a window but was not allowed to speak.' It is recorded that while his father was in prison, Elliott, his elder son, then aged 21, took his father's place on the platform with obvious success.

   George Barton lost his seat in 1879 and later went to the U.S.A.; he practised in San Francisco. On returning to New Zealand he was appointed a judge of the native land court and in 1892 judge of the validation court. He died in France, his wife having predeceased him in 1896. The Cyclopedia described him as a 'gentleman of culture with high abilities, well read and with a large knowledge of the world.'
4. Summary of information about Elliott L'Estrange Barton (1857–1934) from *The Cyclopedia of New Zealand, Vol. 6 1908* and family sources.

   E.L'E. Barton studied law under his father in Wellington and with Mr F.M. Ollivier there. He was admitted as a Barrister and Solicitor of the Supreme of New Zealand in 1881 and shortly afterwards commenced practice in Patea, New Zealand. In 1885 he moved to Hawera, New Zealand and became Solicitor for the Hawera Borough Council and several other bodies. In 1882 he married, at Featherston, New Zealand, Rachel Mary Brown of Tasmania. He apparently shared an interest in electricity supply with his brother as it has been stated that he was responsible for the starting of the first public supply in the town of Gisborne. He died in Auckland.
5. Correspondence with the Otago Early Settlers Museum, Dunedin, 12 April 1985. The High School records are not available.
6. *South East Queensland Electricity Board (SEQEB) Historical Records* Ref. No. 2/93. Letter from Miller and Herbert, Edinburgh to Barton, 28 September 1875. Ref. No. 17/58. Letter from .Herbert and Law, Edinburgh to Barton 28 September 1881.
7. *Journal of the Institution of Electrical Engineers*, Vol. 90. Part I, 1943, p. 531.
8. Sears, J.E. (ed.). *Who's Who in Engineering, 1921–2*, Compendium Publishing Co., London, p. 35.
9. Correspondence with the Hocken Library, University of Otago, Dunedin, N.Z., 20 August 1986.
10. *SEQEB Historical Records* Ref. No. 4/120. Leaving certificate, Karlsruhe Polytechnic Institute.

    Apart from the reference in Appendix A to Barton's conduct, there are two letters dated July 1879 regarding the standard of his work in the final semester. The first was by Professor Keller who lectured on Steam Engine Construction; he complimented Barton on his interest and enthusiasm shown in both his written and laboratory work. Professor Hart who lectured on the Construction of Locomotives stated that Barton obtained very good results and, in particular, 'the construction and thorough testing of his work' earned the 'fullest recognition' of the Professor.
11. Applications by Barton for Associate and later full membership of the Institution of Electrical Engineers, London do not mention Karlsruhe Polytechnic Institute.
12. *SEQEB Historical Records* Ref. No. 9/58. Certificate from Street Commissioner and Road Overseer, Neasho Falls, Kansas, U.S.A.
13. *Qld Parliamentary Papers*, (V & P, LA), 1886 (unnumbered), Report on the 'Accident to the Electric Light'.
14. *SEQEB Historical Records* Ref. Nos 18/53, 19/122, 20/126, 23/58, Letters from Siemens Bros re Barton's services and return to New Zealand, 1882.

15. Haveron, F., 1981. *The Brilliant Ray*. The Godalming Electricity Centenary Celebrations Committee.
16. *Engineering* 13 January 1882.
17. Moralee, D., 1982. Power Engineering : the early struggle. *IEE Electronics and Power* Jan. 1982, pp. 21–25.
18. L'Estrange, F.R., 1954. *Brisbane's Early Electricity Supply*. P.O. Historical Soc., Australian Postal Institute, Queensland Division, Brisbane. Refer also to a series of articles by F.R. L'Estrange published in the *Southern Electric Authority of Queensland News*, 1954 to 1958.
19. Watton, E.B., 1956. *Holborn Viaduct to Calder Hall*. Babcock and Wilcox Ltd, London.
20. First application by E.G.C. Barton for the position of Queensland Government Electrician, 5 March 1886. *Qld State Archives* Colonial Sec. Records, File 1886/1727.
21. Speer, N.M., 1962. *The Electricity Supply Industry in New Zealand* Electricity Supply Association of New Zealand, Wellington.
22. *Waikato Times* 24 May 1883.
23. *New Zealand Parlt. Papers*, 1883. Report on Lighting Parliament Buildings by Electricity.
24. Second Application by E.G.C. Barton for the position of Queensland Government Electrician, 22 April, 1886. *Qld State Archives* Col. Sec. records, 1886/3222.
25. *Brisbane Courier* 9 December 1882.
26. *SEQEB Historical Records* Ref. No. 45/50. Letter G. Barton to E. Barton re work in New Zealand, 23 March 1884.
27. *SEQEB Historical Records* Ref. No. 68/93, Reference concerning Barton's service with the Australasian Electric Light, Power and Storage Co. Ltd, 27 August 1886.
29. Shipping Records. Public Records Office, Victoria.
30. Cannon, M.M., 1975. *Australia in the Victorian Age* Vol. 3, Nelson, Melbourne.
31. *Brisbane Courier* 2 July 1878.
32. F.R. L'Estrange (1889–1968) was employed by Barton in 1904 as an apprentice and served the electricity supply industry in various capacities for over 50 years, his final appointment being as Consumers Engineer, Southern Electric Authority of Queensland. His interest in the history of the industry and in the preservation of documents and artefacts is very evident from a study of the SEQEB Historical Records.
33. *SEQEB Historical Records* Ref. No. 32/101. Draft history of electricity supply in Brisbane, 1961. (incomplete).
34. Conot, R., 1980. *A Streak of Luck*, Bantam Edition, USA. p. 222 refers to the 'first commercial land-based lighting installation' where a printing firm had 240 8 candle power lamps installed in January 1881 in New York.
35. *Figaro*, 21 April, 1883. An advertisement for Alfred Shaw and Co reads as follows: 'We have much pleasure in intimating that we have undertaken to represent Edison Electric Light in this Colony. We have convinced ourselves that in this we have the best application of one of the most important modern discoveries. The Edison Incandescent Light is absolutely safe, remarkably pleasant to the eyes, consumes no oxygen, emits hardly any heat and no fumes ...'
36. *Brisbane Courier* 11 December 1882.
37. *Brisbane Courier* 21 December 1882 and *Queenslander* 30 March 1895.
38. *Brisbane Courier* 12 December 1882.
39. *Brisbane Courier* 9 April 1883.
40. *Brisbane Courier* 14 March 1884.
41. *Queenslander* 24 May 1884.
42. *Brisbane Courier* 20 August 1889.
43. Electrical Progress in Australasia, *Supplement to Australian Mining Standard*, 5 May 1909.
44. *Brisbane Courier* 12 April 1933.
45. *Qld Parliamentary Papers*. (V & P, LA), Vol. III, 1886, Report of Department of Mines.
46. *SEQEB Historical Records* Ref. Nos 49/50, 51/50. Letters G. Barton to E. Barton, 11 June and 27 June 1884.
47. *SEQEB Historical Records* No. 56/50. Letter from G. Barton to E. Barton, 7 October 1884.
48. *Qld Parliamentary Papers*, (V & P, LA), 1884. Report on the 'Electric Lighting of the Parliamentary Buildings'.
49. Wormell, R., 1893. *Electricity in the Service of Man*, Cassell & Co. Ltd, London.
50. Kingsbury, H.H. Extracts from the Report of the Electrical Engineer, 17 March, 1886. *Qld State Archives, Col. Sec. records*, 1886/4751.
51. Matveieff, A.E. Enquiry resulting from Mr Kingsbury's Report, 28 May 1886. *Qld State Archives, Col. Sec. records*, 1886/4751.
52. Tomlinson, T. Application for the position of Queensland Government Electrician, 3 July, 1886. Graduated from Trinity College, Dublin in Arts (1881) and Engineering (1883). Honours in Maths, Gold Medal in English and French Literature. Special Certificate in all Engineering subjects. Experience with Professors Ayrton and Mather in London and elsewhere. *Qld State Archives*, Col. Sec. records, 1886/5026. In Brisbane 1884.
53. Invoice for Edison Street Tubes and Fittings. *Qld State Archives, Col. Sec. records*, 1886/4900. The items included 79 tubes (1375ft) and 79 coupling boxes.

Conot described the first manufacture and installation of the mains in New York thus: 'To prepare the mains, Edison established a tube-works in a twenty foot wide building on Washington Street. There Kruesi [his assistant] presided over kettles of asphalt and linseed oil. Pipes under treatment hung out the windows, and the whole neighborhood suffocated in the stench. ... The first batches of pipe had air holes in the asphalt through which electricity leaked.'
54. *Minutes of the Brisbane Municipal Council.*

Approval for laying a cable in William Street, 28 April 1884.

55. *SEQEB Historical Records* Ref. No. 40/103. L'Estrange, W.M.E. The History of Electricity Supply in Brisbane. Chairman's Address to the Institution of Engineers, Australia, Brisbane Division, 20 April 1934. W.M.E. L'Estrange (1868–1951) joined the firm of Barton and White in 1893 and, except for a few years gaining experience overseas in the late 1890's, served in several capacities in the Brisbane Electric Supply Co. Ltd, the City Electric Light Co. Ltd (successors to Barton and White) and the Ipswich Electric Supply Co. Ltd. His appointments ranged from installation electrician to governing director of the City Electric Light Co. Ltd from which position he retired in 1938.
56. Callender, J.O., 1891. Underground Electric Mains. *Proc. Elec. Assoc. NSW.* Vol. 7.
57. *Qld Government Gazette* 3 November 1886.
58. L.A. Bernays was Clerk of the Queensland Legislative Assembly.
59. A characteristic of Edison's early dynamos was that the field core magnets were unduly long in proportion to the rest of the machine. This led to the factory name of 'Long Legged Mary Ann', later changed to 'Long Waisted Mary Ann' to preserve Victorian sensibilities. A change to shorter magnets occurred about the time of supply of the Brisbane dynamos and it can be assumed from Barton's remarks that the delivery in 1884 was of the new style.
60. *Brisbane Courier* 19 July 1887.
61. Correspondence etc regarding Barton's conditional resignation, re-engagement and termination of employment by the Queensland Government and also regarding the new underground mains is contained in *Qld State Archives* bundle WOR/A 356, 1896.
62. *Brisbane Courier* 7 June 1892.
63. *Qld Government Gazette*, 25 February 1888. Resignation effective 16 February 1888.
64. Index to Colonial Secretary's Office, 1888. *Qld State Archives.*
65. Application by Barton dated 6 November 1895 for admission as Associate, Institution of Electrical Engineers, London states: '... has been senior partner in a firm carrying on a Central Station in Brisbane since 1887.'
66. *Queenslander* 17 March 1888.
67. *SEQEB Historical Records* Ref. No. 74/57. Letter G. Barton to E. Barton, September 1887.
68. *SEQEB Historical Records* Ref. No. - 204 Work Register (miscellaneous records, designs etc chiefly by Barton), 1887–1906.
69. *Queenslander* 10 March and 17 March 1888.
70. *Queenslander* 27 August 1887.
71. *SEQEB Historical Records* Ref. No. 1/168. Note that *India* was not in Brisbane in 1887 or 1888. James Trackson opened an electrical business in Brisbane (later known as Trackson Bros) probably early in 1886. An advertisement in the *Brisbane Courier* of 27 February 1886 described Trackson as an electrical engineer late with the Queensland Government and formerly with the Edison Co.
72. *Brisbane Courier* 24 March 1888.
73. *Brisbane Courier* 14 June 1888. *A Time for a Museum* published by Queensland Museum, 1986 states that arson was suspected
74. *Brisbane Courier* 23 June 1888.
75. *Queenslander* 25 August 1888.
76. Morrison, W.F. (ed), 1888. *The Aldine History of Queensland.* Aldine Publishing Co., Sydney. Reference is made to this illustration but it appears only in Muir and Morcom, *Jubilee History of Queensland* 1888.
77. *Brisbane Courier* 25 July 1888.
78. Ivimey, A.J., 1889. *Mining and Descriptive Queensland.* Muir and Morcom, Brisbane.
79. *SEQEB Historical Records* Ref. No. 140/103. Lists of engine room plant installed at Edison Lane, Ann Street, and William Street power stations.
80. *SEQEB Historical Records* Ref. No. 225/97. Mackenzie, G., historical notes, 1898–1950. Gilbert Mackenzie (1881–1962) commenced service in 1898 with the Brisbane Electric Supply Co. Ltd as an apprentice at the Edison Lane site. He remained with the company and its successor, the City Electric Light Co. Ltd for 52 years in a variety of engineering positions. He retired from the company in November 1952.
81. *SEQEB Historical Records* Ref. No. 82/99. Letter by Barton to Manager, Electric Light Station, Newcastle, 6 August 1896.
82. *Brisbane Municipal Council Minutes* September 1889.
83. *Brisbane Courier* 12 June 1888.
84. *Queenslander* 23 March 1889.
85. *Australasian Ironmonger* July 1889.
86. *SEQEB Historical Records*, Ref. No. 221/98. Letter by Barton to Perry Bros, Brisbane, 24 February 1896.
87. *Qld Parliamentary Papers* (V & A, LA) Vol. III, 1900. Report on Electric Lighting, Railways Department.
88. Mayoral Report, Brisbane Municipal Council, 1902–3.
89. *Qld Parliamentary Papers* 1890. Report of Select Committee of the Legislative Assembly on the Bill to Amend the Brisbane Gas Co. Act of 1864.
90. *Brisbane Courier* 12 August 1890.
91. *Australasian Ironmonger* May 1890.
92. *Brisbane Courier* 21 February 1890.
93. *SEQEB Historical Records* Ref. No. 99/57. Letter from G. Barton to E. Barton, 18 November 1888; Ref. No. 128/59, letter from T.E. White to G. Barton, 16 May 1890.
94. *Queenslander* 23 August 1890.
95. *Australasian Ironmonger* June 1891.
96. *Australasian Ironmonger* September 1891.
97. *Queensland Electrical and Radio World*, Strand

Press, Brisbane, August 1938.
98. *The Building and Engineering Journal* 31 October 1891.
99. *Qld Parliamentary Papers* (V & A, LA), 1891.
100. *Queenslander* 12 November 1892.
101. *Australasian Ironmonger* August 1892.
102. *SEQEB Historical Records* Ref. No. 153/109 Letter from C.F. White to G. Barton, 15 October 1892.
103. Queensland Patent No. 1844, 1891 filed 11 September 1891.
104. *Queenslander* 13 August 1892.
105. *Australasian Ironmonger* April 1893.
106. *Minutes of the South Brisbane Municipal Council* 1893.
107. *SEQEB Historical Records* Ref. No. 201/99. Letter from E. Barton to W.M.E. L'Estrange, 22 November 1897.
108. *Queenslander* 22 July 1893.
109. *Queenslander* 23 December 1893.
110. *Australasian Ironmonger* May 1894.
111. *Australasian Ironmonger* July 1894.
112. *SEQEB Historical Records* Ref. No. 140/98. Letter from E. Barton to Town Clerk, Brisbane, 7 May 1894.
113. *Queenslander* 17 August 1895.
114. *Australasian Ironmonger* September 1894.
115. Anderson, G., 1894. *Report on Public and Other Electric Lighting in Australia, Europe and America*, Adelaide 1894.
116. *Australasian Ironmonger* February 1895.
117. *Queenslander* 30 March 1895.
118. *Australasian Ironmonger* January 1895 and August 1895.
119. *Australasian Ironmonger* August 1895.
120. *Australasian Ironmonger* November 1895 and December 1895.
121. *SEQEB Historical Records* Ref. Nos. 177/94, 178/109, 178A/180, 179B/130, 179C/130. Letters from G. Barton to E. Barton February to April, 1895.
122. *Australasian Ironmonger* December 1895.
123. Supreme Court Liquidations. *Qld State Archives* File 1501, 1895.
124. *Australasian Ironmonger* February 1896.
125. L'Estrange, F.R., *Southern Electric Authority of Queensland News* July 1955.
126. *Queenslander* 19 June 1897.
127. *SEQEB Historical Records* Ref. No. 75/98. Letter from E. Barton to T.E. White, 28 August 1893.
128. *Australasian Ironmonger* May 1896.
129. *Qld Parliamentary Debates* 1896.
130. Department of Post and Telegraph, Queensland document D2453, 23 February 1897. Letter Barton to J. Hesketh, 18 February, 1897 giving description of works to 1 September 1896.
131. *Queenslander* 18 July, 1896, and *Proc. R. Soc. Qd* Vols. 86-88.
132. *Salute to the X-ray Pioneers of Australia*. W. Watson and Sons Ltd, Sydney, 1946.
133. *Australasian Medical Gazette* 20 November 1897.
134. *Brisbane Courier*, 21 September 1897.
135. Hesketh, J., Report on the Electric Lighting of the City of Brisbane, A.J. Ross & Co., Brisbane. See also *SEQEB Historical Records* Ref. No. -/169.
136. *Australian Mining Standard* 5 July 1900.
137. *SEQEB Historical Records* Ref. No. 138/78. Note by Barton to shareholders on history of the City Electric Light Co. Ltd, updated to 1928.
138. Hesketh, J., 1898. Presidential Address. *J Queensland Electrical Association*, Vol. 1, No. 1.
139. City Electric Light Co. Ltd Directors Report, 31 December 1907.
140. Memorandum of Association, City Electric Light Co. Ltd.
141. City Electric Light Co. Ltd, Directors Report, 31 March 1905.
142. City Electric Light Co. Ltd, Directors Report, 31 July 1906.
143. *SEQEB Historical Records* Ref. No. -/100. Letter from E. Barton to Crompton & Co., London, 8 March 1907.
144. *Brisbane Courier* 1 November 1909.
145. *Brisbane Courier* 27 June 1910.
146. *SEQEB Historical Records* Ref. No. -/925A-J. Plans by W. Vincent for development of the William Street power station 1913.
147. City Electric Light Co. Ltd, Directors Report, 31 July 1910.
148. City Electric Light Co. Ltd, minutes of Directors Meetings, 1916.
149. City Electric Light Co. Ltd, minutes of Directors Meetings, 1917.
150. *Australian Mining Standard* 13 August 1914.
151. *Brisbane Courier*, 28 September 1914.
152. Morwood, J.E., 1968. History of Electricity Supply in Brisbane. *Institution of Engineers, Australia, Queensland Division, Technical Papers* July 1968.
153. *SEQEB Historical Records* Ref. No. -/213. 'Goods Received' Book.
154. Correspondence with Messrs Babcock Australia, 24 November 1987.

All Babcock and Wilcox boilers supplied to the William Street Station were equipped with superheaters and chain grate mechanical stokers and the complete installation with brickwork settings was carried out by the supplier. For the higher pressure boilers (210 lb per sq. in.) the orders also included Green's economisers, chimneys, galleries, ladders and the feedwater systems.

Referring to the 1913 layout plans, the intention was evidently to adopt the size of boiler initially supplied for future installations. The intention appears to have been to use a single large chimney to serve the ten boilers, assisted by motor driven induced draught fans. However, because larger units were subsequently installed and higher steam pressure and temperature were adopted, integral economisers and independent chimneys were included.

155. *Brisbane Courier* 30 October 1909.
156. *Daily Mail* 27 April 1914.
157. Ipswich Electric Supply Co. Ltd, Minutes of Directors' Meetings 1917–37. *Qld State Archives* A29347.
158. *Australasian Ironmonger* August 1890.
159. *Australasian Ironmonger* May 1891.
160. *Australasian Ironmonger* July 1891.
161. *Australasian Ironmonger* June 1897.
162. *Australasian Ironmonger* November 1900.
163. *Australasian Ironmonger* February 1892.
164. *Queenslander* 28 January 1893. Mr Paterson was probably Henry Paterson, Post Office Stores, Thargomindah whose advertisement in the Thargomindah Herald and Coopers Plains Advertiser of 23 August, 1884 described his occupation as General Storekeeper, Wine and Spirit Merchant.
165. Annual Report of Hydraulic Engineer. *Qld Parliamentary Papers* Vol. III, 1895/6.
166. *Australian Handbook* 1896 et seq.
167. Department of Post and Telegraph, Queensland document D 7137, June 1897.
168. *Queenslander* 29 May 1897.
169. *Queenslander* 9 April 1898.
170. *Brisbane Courier* 18 November 1898.
171. Department of Post and Telegraph, Queensland, Document D 13954, 11 October 1898.
172. *Qld Parliamentary Papers* (V & P, LA) Vol. III, 1891. Report of Technical College, Brisbane School of Arts for year ending 31 December 1890.
173. *Brisbane Courier* 28 August 1884.
174. *Brisbane Courier* 24 July 1884.
175. *Brisbane Courier* 9 July to 1 October 1889.
176. *Brisbane Courier* 3 September, 1889 (Note: *Australasian Ironmonger* February 1894. J. Dorsett, Engineer, Government Printing Office was put in charge of the electric lighting of the Parliamentary buildings).
177. *Brisbane Courier* 8 October 1889.
178. *Brisbane Courier* 18 January 1890.
179. A list of many reports in the *Queenslander* of lectures given by Barton has been made by the author.
180. *Queenslander* 1 December 1900.
181. Brisbane School of Arts, Annual Report, 1894/5.
182. Manuscript Collection, OM 64-15, John Oxley Library.
183. *SEQEB Historical Records* Ref. No. 98/99 Syllabus details, Electrical Engineering Courses, Brisbane Technical College, c.1896.
184. *Brisbane Courier* 27 March 1902. Advertised as 'Wireless Telegraphy and its position in regard to Submarine Cables'.
185. *Brisbane Courier* 18 November 1903.
186. Wyeth, E.R., 1953. *Education in Queensland*. Australian Council for Educational Research, Melbourne.
187. Report on Brisbane Technical College, Brisbane School of Arts, for 1900–01. *Qld Parliamentary Papers* Vol. I, 1902.
188. *Qld Parliamentary Papers* (V & P ,LA), Vol. II, 1905.
189. *Queenslander* 10 June 1899.
190. L'Estrange, F.R., *S.E.A. News* November 1956.
191. *Queenslander* 3 February 1894.
192. Report of ANZAAS Conference, Brisbane, January 1909; *Brisbane Courier* 16 January 1909.
193. *Brisbane Courier* 16 November 1906.
194. *The University of Queensland, 1910–1922*. Queensland Government Printer, Brisbane, 1923. During Professor Gibson's absence, J.P. Tivey BE, BSc, an electrical engineer, was Acting Professor of Engineering. Tivey was the first lecturer appointed to the new department; he resigned in 1912.
195. Brier, P., 1962. *Pioneers of Music*. University of Queensland, The Musical Association of Queensland.
196. Corbett, A.H., 1973. *The History of the Institution of Engineers Australia 1919–1969*. Institution of Engineers Australia and Angus and Robertson, Sydney.
197. *Australasian Ironmonger* September 1890.
198. *Brisbane Courier* 6 November 1890.
199. *The Building and Engineering Journal* 31 October 1891.
200. *Queenslander* 26 November 1892.
201. *Queenslander* 29 April 1893.
202. *Australasian Ironmonger* February 1894; *Pugh's Almanac* (Gordon and Gotch, Brisbane) 1895, 1896.
203. *Minutes of Meeting of Queensland Institute of Engineers* 27 October 1905.
204. *Journal of Queensland Electrical Association* Vol. I, No. 1, 1898.
205. *Journal of Queensland Electrical Association* Vol. II, Part 1, No. 6, 1899.
206. *Journal of Queensland Electrical Association* Vol. II, Part III, No. 8, 1901. (The purpose of the Morse Sounder is to detect acoustically the Morse Code signals used in telegraphy. The device is simply an electromagnet to which a lever is attached and moves between two stops one of which it strikes when attracted and the other when it is released. The time elapsing between the two sounds is short or long corresponding to a dot or a dash in the Morse Code message.)
207. *Journal of Queensland Electrical Association* Vol. II, Part V, No. 10, 1901.
208. Minute Book, Queensland Institute of Engineers (1900–1919), Fryer Library, University of Queensland.
209. *Brisbane Courier* 13 April 1901.
210. *Brisbane Courier* 20 April 1905.
211. *Brisbane Courier* 26 October 1906.
212. Barton, E.G.C., 1907. *Electricity in the Service of Women*. Queensland Electrical Association, 18 May 1907. (Preprint).
213. *Brisbane Courier* 30 November 1909.

214. *Journal of Institution of Engineers, Australia* Vol. 1, 1920.
215. *Minutes of the Faculty of Engineering*, University of Queensland, 1925.
216. Institution of Electrical Engineers, London, Archives.
217. *Queenslander* 15 February 1908.
218. Bernays, C.A., 1919. *Queensland Politics during Sixty Years*. Government Printer, Brisbane.
219. *Qld Parliamentary Debates* Vol. 101, 1908.
220. *Queenslander* 15 August 1908.
221. *Qld Parliamentary Debates* Vol. 102, 1908.
222. *Pugh's Almanac*. Gordon and Gotch, Brisbane, 1910 to 1919. The Directors of the City Electric Light Co. Ltd evidently did not share Barton's interest as the minute books of the Company show that once, in August 1912, they donated £1 1s 0d and one month's free supply of electricity.
223. Correspondence with the Royal Geographical Society, London, 1986–7. Barton was proposed for Fellowship of the Society by Alexander Siemens who was Manager of the Electric Light Department of Siemens Bros, London at the time Barton was employed in this Department, in 1882. Siemens became President of the I.E.E., London in 1894 and President of the I.C.E., London for 1910–11.
224. *Australian Encyclopedia* Vol. 9, The Grolier Society of Australia, 1965.
225. *Qld Geog. J. (N.S.)* Vol. 22, 1906/7, p.98.
226. Barton, E.C., 1909. Summary of the Proceedings of the 9th International Geographical Congress Held at Geneva in 1908. *Qld. Geog. J. (N.S.)*, Vol. 24, p.13–25.
227. *Queenslander* 3 October 1908.
228. Barton, E.C., 1911. Weather and Its Causes. *Qld Geog. J. (N.S.)*, Vol. 26/27, p.16–37
229. *Qld Geog. J. (N.S.)*, Vol. 30/31, 1914/16, p.98.
230. *SEQEB Historical Records* Ref. No. -/184. Notes by F.R. L'Estrange on estuaries etc.
231. Private communication.
232. *Telegraph* (Brisbane), 1 May 1911.
233. *The Decimal Educator*, June 1920.
234. *Watford Observer* 19 June 1942.
235. Correspondence with the University of Cambridge Library, 11 August 1986.
236. *Queenslander* 11 July 1914.
237. Information about the career of Joseph George Elliott Barton is incomplete but he is believed to have enlisted in the British Expeditionary Force and served in World War I. Presumably the Lieut. G.E. Barton who attended a farewell function for E.C. Barton in London in April 1920 was the latter's son. J.G.E. Barton matriculated at Gonville and Caius College, Cambridge University in 1921 and obtained first class honours in Geography in 1925 having also read Mathematics and Medieval and Modern Languages.

Correspondence with the Royal Geographical Society, London shows that Barton Jr was a keen traveller and explored the Francisco River in Brazil from the source to the sea in the early 20's. He later worked in Burma and in 1932 received a letter of commendation by the Governor.
238. Will of E.G.C. Barton, *Qld State Archives*, 1262/1943 (Southern Division).
239. *Courier Mail* 20 June 1942.

APPENDIX A

COURSE DETAILS — KARLSRUHE POLYTECHNIC INSTITUTE, GERMANY, 1875–79 FOUR YEAR (EIGHT SEMESTERS) ENGINEERING COURSE UNDERTAKEN BY E.G.C. BARTON

The evidence that Barton attended the course is contained in a Leaving Certificate issued on 25 July 1879. This lists the subjects in the course and ends with — 'The conduct of Mr Barton while a student here has given no grounds for any complaint.'

It is assumed, although not stated, that he passed all subjects and thus completed the four year course.

Details of the course may be summarised as follows — The first year is described as a 'Preparatory Course in Mathematics'. The first semester includes Plane and Spherical Geometry, Differential and Integral Calculus, Mineralogy. The second semester includes Astronomy, Elements of Analytical Geometry, Elements of Mechanics, Geology. The second year is described as 'Mathematical School, First Course'. The first semester includes Plane and Spherical Geometry, Differential and Integral Calculus I, Analytical Geometry, Descriptive Geometry, Planning and Terrain Drawings, Experimental Physics I. The second semester includes Differential and Integral Calculus, Elementary Mechanics, Experimental Physics II, Experimental Organic Chemistry. Freehand Drawing is listed in all of the four semesters. The third year is described as 'Machine Construction School'. The first semester includes Theoretical Mechanics I, Elements of Machine Construction, General Theory of Machines, Statics, Freehand Drawing. The second semester includes Instruction in Manipulative Techniques, Thermodynamics and Hydraulics, Machine Construction, Machines for Lifting. The fourth year is described as 'Machine Construction II'. The first semester includes Machine Construction, Theory of Machines, Kinematics, Metallurgy, Mineralogy, construction of Hydraulic Machines, Railroad Tracks, Mechanical Technology, Laboratory Practice in Mineralogy. The second semester includes Steam engine Construction, Construction of Locomotives and Railway Tracks, Mechanical Technology, Elements of Practical Geometry.

APPENDIX B

ITEMS DESIGNED BY BARTON AND RECORDED IN HIS NOTEBOOKS (68,153)

Appliances and measuring devices — Dental motor, electric fans, electric shock machines, energy meter, galvanometer, gramophone, ammeters and voltmeters, lightning conductors and arresters, magnetic separators (dry and wet), milliammeter, rheostats, signal bells, switchboards, switches (knife type), time switches, underwater electric light, fire alarms.

Distribution systems — Lines and cables.

Installations — Cold storage plant (Roma St) — calculations, sugar mill lighting, town and institution lighting, dredge lighting.

Power plant — Dynamos and motors in a wide range of sizes.

APPENDIX C

THE QUEENSLAND GOVERNMENT ELECTRICAL ENGINEER'S SCHEME FOR A BRISBANE MUNICIPAL COUNCIL POWER STATION, 1897.

DRAFT SPECIFICATION AND ESTIMATES.

SCHEME 1.

PLANT TO GENERATE AND DISTRIBUTE 400 KILOWATTS OF ELECTRICAL ENERGY IN THE CITY OF BRISBANE.

	£
SITE.—In the position indicated on the map * ...	6,000
BUILDINGS.—Plain, and capable of extension at small cost. To include foundations, flues, and chimney 120 feet high	4,500
BOILERS.—Capable of evaporating 12,000 lbs. of water hourly, to be of the water-tube pattern, fitted with all accessories; electrically driven pumps in duplicate, exhaust fan in main flue for assisting rapid steam raising, &c. ...	2,500
FEED, STEAM AND EXHAUST PIPES.—Drains, feed tanks, hot well, &c., pipes arranged on ring system so that any breakage would not mean stoppage of supply	500
CONDENSERS.—To be independent surface condensers, to the full capacity of the engine power, with electrically driven pumps in duplicate, with all pipes, valves, &c., for working condensing or non-condensing at will	1,750
GENERATING AND REGULATING PLANT.—4 vertical, compound condensing engines, coupled direct to continuous current dynamos of a capacity of 100 kilowatts each, at a pressure of 440 volts ... ... 2 motor transformers, each of 50 kilowatt capacity, transforming from 220 to 220 volts, for balancing purposes	6,500
SWITCHBOARD.—To be arranged for the specified dynamos, motor-transformers, batteries, mains, and feeders, with all necessary instruments	1,250
BATTERY.—Of 225 cells, capable of giving a discharge of 150 amperes for 7 hours	2,000
MAINS AND FEEDERS.—To be of a total length of 10 miles of 3 core cable, insulated with bituminised fibre or paper, lead covered, and laid in wood troughing protected by bitumen or other approved substance. To be laid at an average depth of 18 inches below the surface of the footway, and to be fitted with all necessary junction and inspection boxes ...	10,500
METERS.—300 in number, of the Thomson Wattmeter type, with maximum demand indicator ...	2,100
INCANDESCENT STREET LAMPS.—1,220 in number, adapted to present Gas standards ...	8,660
STREET ARC LAMPS.—32, fitted in special pillar ...	1,600
INTERNAL WIRING.—Capital necessary for internal wiring, to be repaid by the consumer as by arrangement	1,500
Total	£44,360

Of which—£28,726 is on Private Lighting Account,
£14,134 is on Public Lighting Account, and
£1,500 on Wiring Account.

SCHEME 2.

SIMILAR PLANT OF A CAPACITY OF 300 KILOWATTS.

	£
SITE	
BUILDINGS	1,500
BOILERS	1,875
PIPES	875
CONDENSER	1,200
GENERATING PLANT	5,000
SWITCHBOARD	900
BATTERY	1,500
MAINS AND CABLES (20 miles)	18,500
METERS	1,400
STREET LAMPS	5,000
Total	£32,250

Of which—£18,633 is on Private Lighting Account, and
£13,617 on Public Lighting Account.

APPENDIX D

DEVELOPMENT OF ELECTRICITY SUPPLY BY BARTON, WHITE AND CO. AND THEIR SUCCESSORS IN BRISBANE, 1888 TO 1920[1]

Legend: A: Year
B: Installed Capacity[2] (kW)
C: Maximum Demand[3] (kW)
D: Annual Energy Generated[4] (millions of kWh)
E: Gross Annual Revenue[5] (thousands of £)
F: Estimated Average Revenue[6] per kWh (pence)
G: Number of Consumers

A	B	C	D	E	F	G
1888	7-31					
1889						
1890				1.0		
1891				1.9		
1892	52?			2.2		80
1893		c.42		2.6		
1894				2.9		
1895		c.50	0.07	3.1		92
1896	78				6.0	
1897				3.5		
1898	74	67	0.18	5.2	6.0	
1899	120	96	0.25	6.3	4.8	107?
1900	150	121	0.26	6.6	4.9	
1901	200	156	0.37	7.6	4.4	194
1902	275	174	0.49	9.3	4.4	240
1903	375	174	0.62	10.6	4.2	286
1904		225	0.71	13.1	4.5	294
1905	375	361	0.89	14.0	3.8	344
1906	525	415	1.26	18.5	3.5	
1907	725	569	1.48	22.5	3.7	
1908	725	572	1.94	26.6	3.3	
1909	(+700)	720	2.10	31.7	3.6	450+
1910		695	2.10	39.1	4.5	
1911	(+1200)	905	2.74	49.0	4.3	
1912						
1913				73.0		600
1914	(+1000)		4.81	89.1		780

1915	1920	5.44	101.2		1055
1916	2350	5.94	110.9		1192
1917	2264	6.17	111.6		1307
1918	2885	7.48	125.0	3.8	2600
1919(+5000)	3400	10.11	150.0	4.0	4471
1920(+5000)	5337	18.27	216.0		5652

1. Data are assembled from many sources and it cannot be assumed that each value in a column has been derived on the same basis. There may be discontinuities between successive years which are misleading. The data should be regarded as showing the general trend in development.

2. The values of the 'Installed Capacity' have been estimated for the end of a calendar year but the variety of generating plant and the lack of information about the incidence of the early additions make such estimates uncertain. Most values to 1906 are from scattered notes in SEQEB Historical Records No. 203. Thereafter values are deduced from data in Directors' and other Company reports. Over the period 1908 to 1920 the values shown in brackets are *additions* in a particular year. The lack of information about retirement of the early plant makes it unrealistic to enter cumulative figures but it seems unlikely that any turbine plant was retired until the 5000 kW set was installed at William St in 1919.

3. Values of 'Maximum Demand' before 1898 are taken from the above SEQEB Document. Those for 1898 to 1911 are taken from Queensland Government Gazettes and thereafter to 1919 from Annual Reports by the City Electric Light Co. Ltd Directors, Chairman or Manager. The 1920 value is from 'Pioneering Power', a Southern Electric Authority of Queensland publication, January 1954.

4. Refer to Note 3 for sources. All values of 'Annual Energy Generated' are for a calendar year until 1904 where the period is 13 months (1 January 1904 to 31 January 1905). Thereafter the 'year', although indicated as a calendar year, is from 1 February to 31 January of the following year. Hence the values given correspond to slightly different periods from those shown. The value for 1914 is derived from a City Electric Light Co. Ltd report for 1941, reviewing the earlier years.

5. Refer to Note 3 for sources. 'Gross Annual Revenue' includes all sources of revenue. Some information for the period 1899 to 1902, given by W.M.E. L'Estrange in a letter dated 24 August 1906, differs considerably from the official returns to the Government as used in the schedule.

6. The values for the 'Estimated Average Revenue per kWh' are in general calculated from the revenue from energy sold. For 1896 the value is taken from the above SEQEB Document. There is some ambiguity in determining the revenue partly because of the doubt as to whether rentals of meters and motors are included in particular years. The most definite information was that given as evidence before the Royal Commission on Electricity in 1936 when the average charge for energy by the City Electric Light Co. Ltd was quoted as 3.234 pence per kWh for the year ending 31 January 1914.

7. The 'Number of Consumers' for 1892 is taken from the *Queenslander* of 12 November 1892 and for 1895 from the above SEQEB Document. For 1901 to 1905, the 1906 letter by L'Estrange lists the number annually. The number in about 1909 is given in the Australian Mining Standard, 5 May 1909 and the numbers for 1913 to 1918 inclusive are derived from the City Electric Light Co. Ltd Manager's report of 1919. The number in 1919 is from a letter (Engineer and Manager to Chairman) dated 2 March 1920 and the 1920 value is from 'Pioneering Power'. It is not known whether or not consumers in areas receiving bulk supply of electricity were included.

APPENDIX E

PUBLICATIONS AND LECTURES BY E.G.C. BARTON — PROFESSIONAL ENGINEERING SOCIETIES, 1891 TO 1922

Abbreviations:

QIMechE — Queensland Institute of Mechanical Engineers

QEA — Queensland Electrical Association

QIE — Queensland Institute of Engineers

IEA — Institution of Engineers, Australia, Brisbane Division

"Electrical engineering". (QIMechE) Early 1891.

"The phonograph". (QIMechE) 15 October 1891. *Building, Engineering and Mining Journal*, 31 October 1891.

"Elementary manual instruction". (QIMechE) July 1893. (*Queenslander*, 29 July 1893)

"Hermite process of sanitation". (QIMechE) September 1894. (*Queenslander*, 29 September 1894)

"Ammonia refrigerating machines". (QIMechE) June 1895. (*Queenslander*, 22 June 1895)

"Interior wiring". (QEA) *Journal QEA* Vol. I, Pt II, 1898, No. 2.

"Presidential address". (QEA) *Journal QEA* Vol. II, Pt I, 1899, No. 6.

"Theory and practice". (QIE) April 1901. Preprint.

"Electric transmission of power". (QIE) June 1901. *Queensland Electrical and Radio World* 20 August 1937.

"The Morse sounder — a study in induction". (QEA) *Journal QEA* Vol. II, Pt III, 1901, No. 8.

"Electric railroads — polyphase versus continuous currents". (QEA) *Journal QEA* Vol. II, Pt V, 1901, No. 10.

"Irrigation". (QIE) 16 May 1902.

"Feed pumps". (QIE) 28 April 1904.

"The horse power of an electric motor". (QEA) 17 November 1904. Preprint.

"Recent improvements in electric lighting". (QEA) 19 June 1906. Preprint.

"Notes on a voyage of discovery in the workshops of Europe". (QIE) 25 October 1906.

"Electricity in the service of women". (QEA) 18 May 1907. Preprint.

"Some reasons for using higher steam pressures". (QIE) 30 August 1909.

"Status of engineers and the affiliation of engineering societies throughout Australia". (QIE) 29 October 1909.

"Colloids in engineering". (QIE) 10 October 1912.

"Condensation economics in steam plant". (QIE) 25 September 1914.

"High power mercury arc rectifiers". (IEA) 18 August 1922.

"Mapping from the air". (IEA) 20 October 1922

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